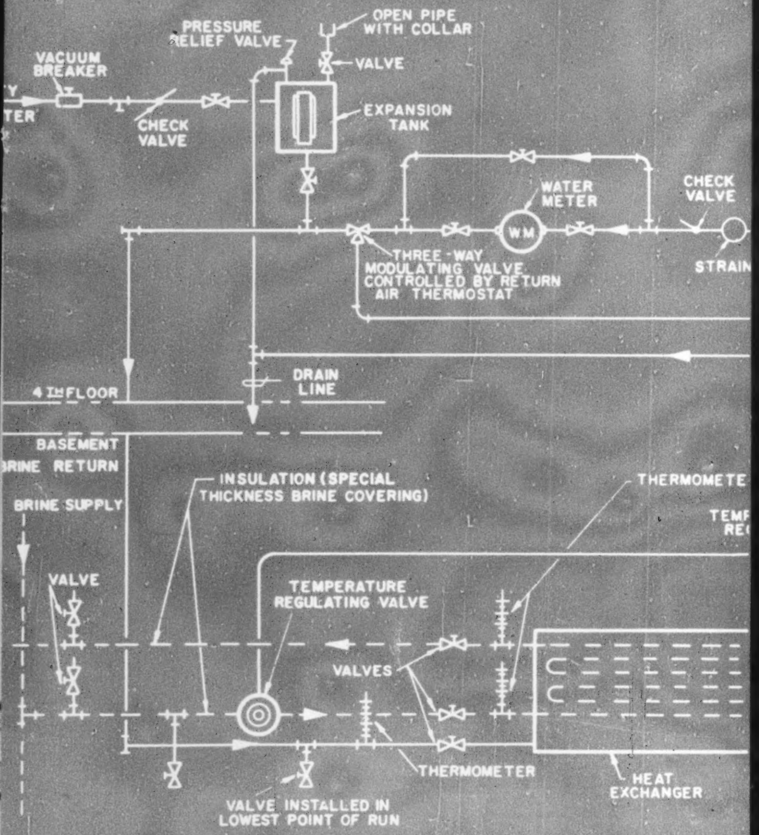
NOVEMBER 1954

Heating Piping & Air Conditioning

INDUSTRIAL • COMMERCIAL • INSTITUTIONAL • PUBLIC BUILDINGS

Page 135—Journal Section of The American Society of Heating and Ventilating Engineers


PRESSURE RELIEF VALVE
OPEN PIPE WITH COLLAR
VACUUM BREAKER
VALVE
TY
TER
CHECK VALVE
EXPANSION TANK
WATER METER
WM
CHECK VALVE
THREE-WAY MODULATING VALVE CONTROLLED BY RETURN AIR THERMOSTAT
STRAIN
4TH FLOOR
DRAIN LINE
BASEMENT
BRINE RETURN
BRINE SUPPLY
INSULATION (SPECIAL THICKNESS BRINE COVERING)
THERMOMETE
TEMP
REG
VALVE
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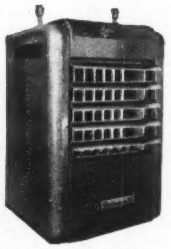
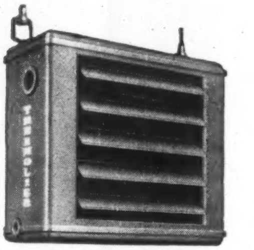
HEAT

where you want it
when you want it
whatever the fuel you use

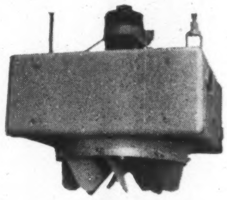
GRINNELL UNIT HEATERS



Horizontal Gas-Fired Model for natural, manufactured, mixed and LP Gases.



Horizontal Model for steam and hot water systems.



Vertical Model for steam and hot water systems.

Grinnell quality is well known. The "Grinnell" name is backed by over 60 years of heating experience. Regardless of the type and model you choose, you can depend on a Grinnell Unit Heater to give balanced heating performance plus maximum fuel economy. Call on Grinnell . . . for the unit heater to meet your specific needs.

GRINNELL
Gas-Fired Unit Heater

Available in 7 sizes — ranging from 25,000 to 200,000 Btu per hour input

Grinnell Gas-Fired Unit Heaters are easy to install, simple to operate and maintain. Efficient performance is assured — with any type of gas — by modern design of burners and heat exchanger, proper motor and fan unit. Automatic safety pilot operates to shut off main gas supply if pilot goes out. Flashback and extinction noise prevented by the burners' raised port design and proper port size for the gas used. American Gas Association approved.

GRINNELL THERMOLIER
Steam/Hot Water Unit Heater

4 models . . . 18 sizes — from 35,600 to 275,300 total heat delivered, Btu per hour

Three basic models—horizontal, vertical and a special horizontal Textile model. (Adjustable velocity nozzle also available for use on horizontal models.) All models have plain thermostatic trap, the simplest and least expensive kind of a trap, made practical because of unit's exclusive internal cooling leg; maximum capacity provided and destructive water hammer eliminated by built-in pitch of tubes. Many other important features.

GRINNELL
WHENEVER PIPING IS INVOLVED

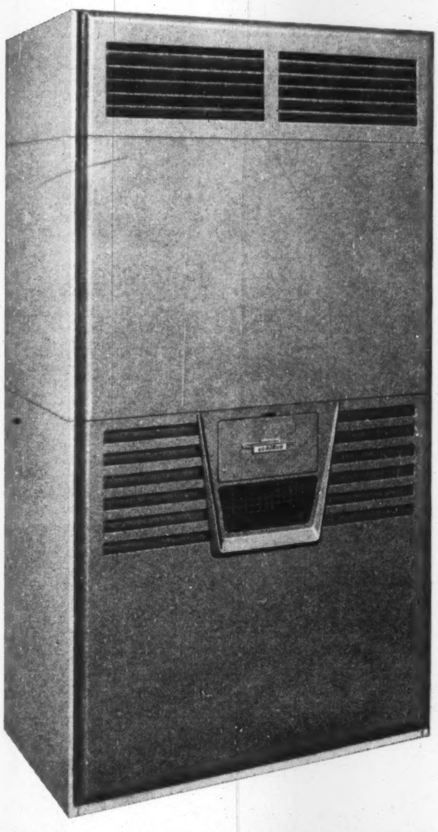
Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

usAIRco

Packaged air conditioners cool Seascape "Motels within a Motel"

SEASCAPE
AIR
CONDITIONED



6 USAIRCO packaged air conditioners, self-contained water cooled units, cool the five individual guest buildings plus lobby and coffee shop of the Seascape Motel, Miami Beach, Florida. One 7½ hp. unit is located in each of the 10-room guest buildings, while one 7½ hp. conditioner cools the lobby and coffee shop.

USAIRCO's unusually flexible packaged air conditioner cleans, cools and dehumidifies the air. The assemblage consists of three component sections—conditioner, blower and plenum permitting rearrangement in the field to fit any problem. All three sections bolt together easily with rubber gasket to insure airtight seal. Spring mounting insures noise-free compressor operation. The central control panel simply flips down to give convenient access to every control.

The cabinet is a handsome modern design of 2-tone baked enamel hammerloid finish with rugged angle iron frame construction, entirely bonderized for longer life. The USAIRCO packaged air conditioner occupies little floor space and comes complete with internal water piping, ready for connection to city water supply or cooling tower. The compressor motor is warranted for five years. All other parts carry a one year warranty.

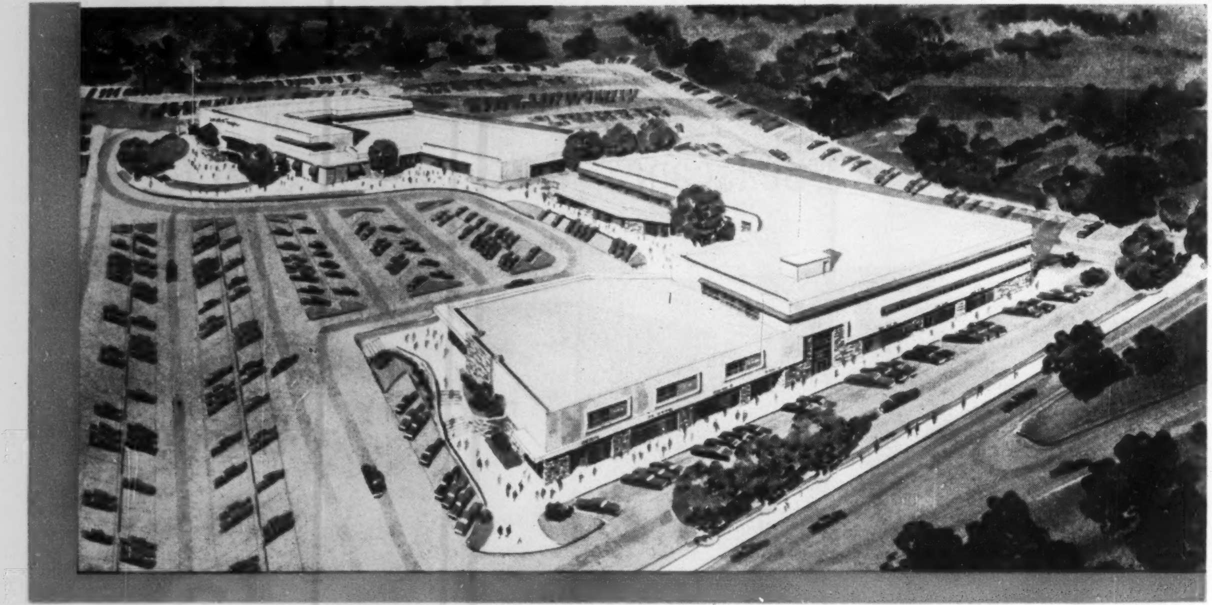
By adding a heating coil, the unit provides effective year 'round air conditioning. The USAIRCO packaged air conditioner is easily installed, with or without ductwork. In 6 sizes, from 2 to 15 hp., the unit is the ideal application for motels, offices, theaters, stores, beauty shops and restaurants. Contractor for the Seascape installation was George Winston Construction Co. Air Conditioning Contractor was Airko Air Conditioning Co. of Miami Beach.

For complete descriptive Bulletin 77-5 write Dept. HP-114

UNITED STATES AIR CONDITIONING CORPORATION

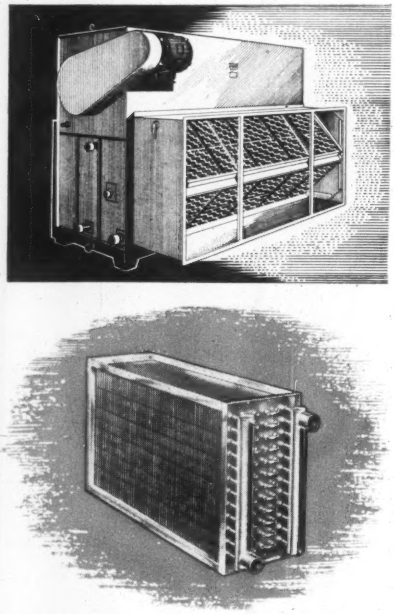
MINNEAPOLIS 14, MINNESOTA • *Export: 13 E. 40th Street, New York 16, N. Y.*

usAIRco
30 YEARS OF AIR CONDITIONING



CONSULTING ENGINEER: HARRY H. BOND
CONTRACTOR: FREDERICK RAFF CO.

600 TONS OF AIR CONDITIONING BY BUSH... for West Hartford Shopping Center



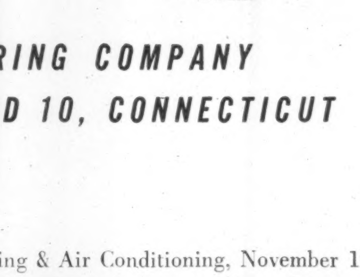
At the new Bishop's Corner shopping center, West Hartford, Conn., every provision has been made for customer and employee comfort. In keeping with the keynote on quality, over 600 capacity-tons of BUSH air conditioning and heating products were selected.

Prominent among Bush equipment installed are Air Handling Units in both vertical and horizontal models. Advantages of these versatile central station units are many: rigid angle iron framing and self-aligning ball bearings assure long life, eliminate vibration and guarantee quiet operation.

All units have built-in by-pass sections to provide 100% air by-pass when required. Centrifugal type fans, mounted on a common solid steel shaft, are statically and dynamically balanced for quiet, efficient operation. Matching housing with scroll for each fan insures smooth air flow.

Capacities range from 800 to 21,600 CFM, with nominal ratings from 3 to 65 tons. Face and by-pass dampers, humidifiers and both throw-away and cleanable type filters are available for all units.

Catalog 710A, free on request, contains complete specifications.



BUSH

BUSH MANUFACTURING COMPANY
WEST HARTFORD 10, CONNECTICUT

Heating Piping & Air Conditioning

Vol. 26 No. 11

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

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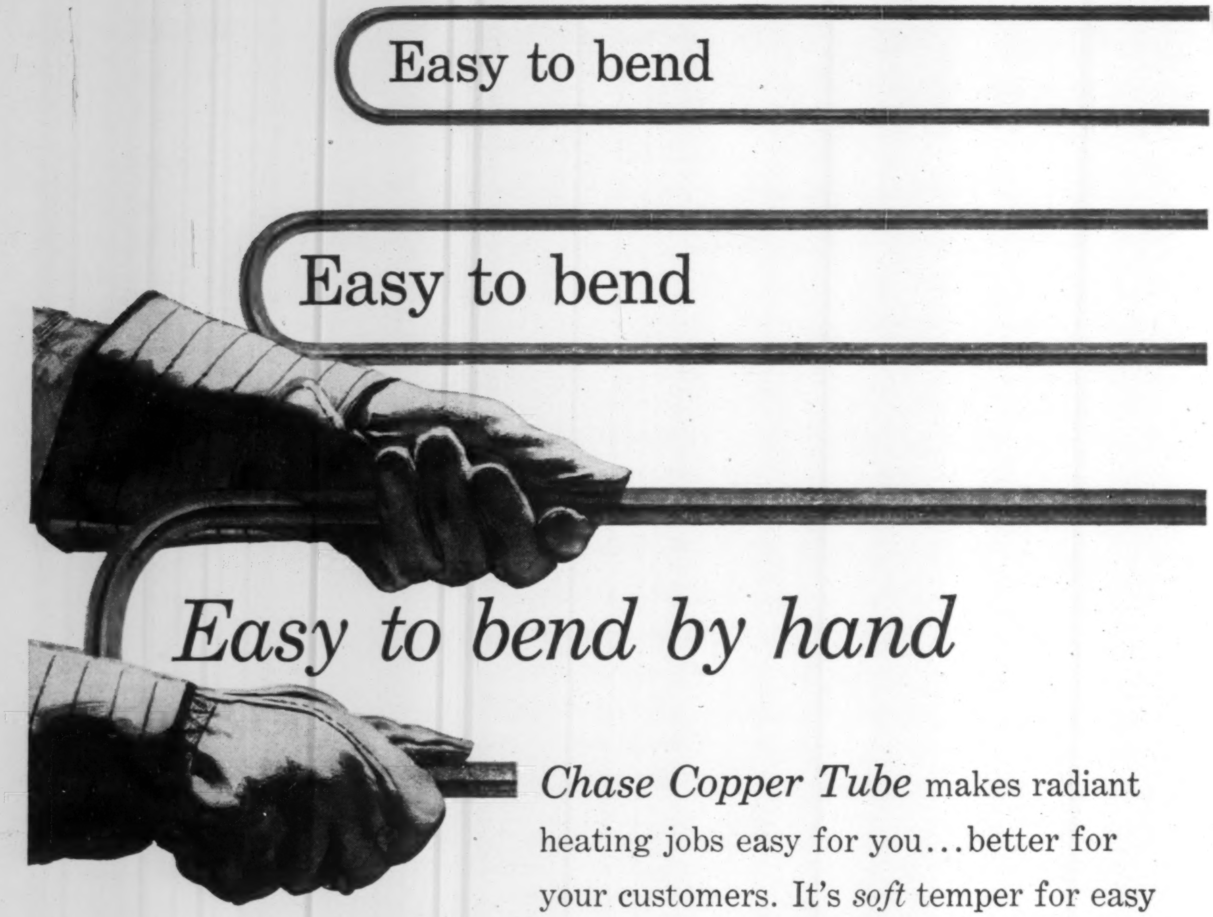

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Easy to bend

Easy to bend by hand

Chase Copper Tube makes radiant heating jobs easy for you...better for your customers. It's *soft* temper for easy bending...*light* for easy handling...and it comes in long lengths—so fewer joints are needed. Combined with Chase Solder-Joint Fittings, it makes a leak-proof, pressure-tight, *quality* system that's corrosion-resistant and can't clog with rust—*ever*. Order from your Chase wholesaler.

Chase®

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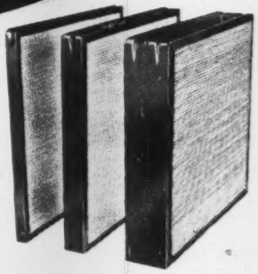
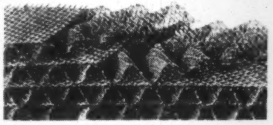
THE MEASURE OF A GOOD AIR FILTER

1", 2" or 4" thick?



Whether you need filters for package air conditioners or furnaces, for general filtration or for special applications requiring the highest efficiency and greatest dirt capacity, Farr Company has a standard type to fit the job—available in steel, aluminum, copper, stainless and monel.

How much media?



In FAR-AIR° filters you get more media per square inch *plus* the famous herringbone-crimp design that assures greater dirt holding capacity and lower pressure loss. Firmly packed media provides even density and assures uniform high efficiency over the entire filter area.

ORIGINATORS OF FAR-AIR CERTIFIED FILTER SERVICE

FARR COMPANY

NO COMPROMISE ON QUALITY

Los Angeles, New York, Chicago, Memphis

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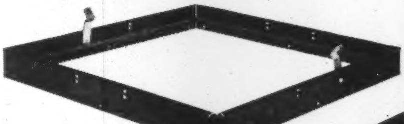
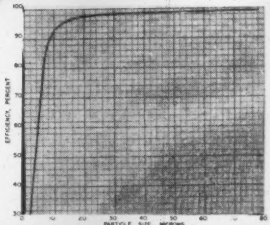
°Trade Mark

What kind of construction?



Heavy gauge filter frames and interlocking holding frames assure rigid filter banks and proper fit. Reinforcing rods drilled through the filter media make the filter more rugged. *Engineered* quality assures longer service life.

How efficient?



FARR COMPANY
P. O. Box 45187, Airport Station
Los Angeles 45, California

☐ Send efficiency curves
☐ Send a Farr Field Engineer

Name__________ Title__________

Company__________

Address__________

High efficiency in a filter is its only real reason for existence. FAR-AIR° filters consistently deliver superior performance. Send for your set of efficiency curves which show how the various types of FAR-AIR° filters will perform for you.

How Honeywell Customized Temperature Control can help satisfy your clients

Provide ideal working weather the year 'round

New Continental Paper Company offices show why Honeywell Customized Temperature Control is becoming a "must" in all types of buildings.

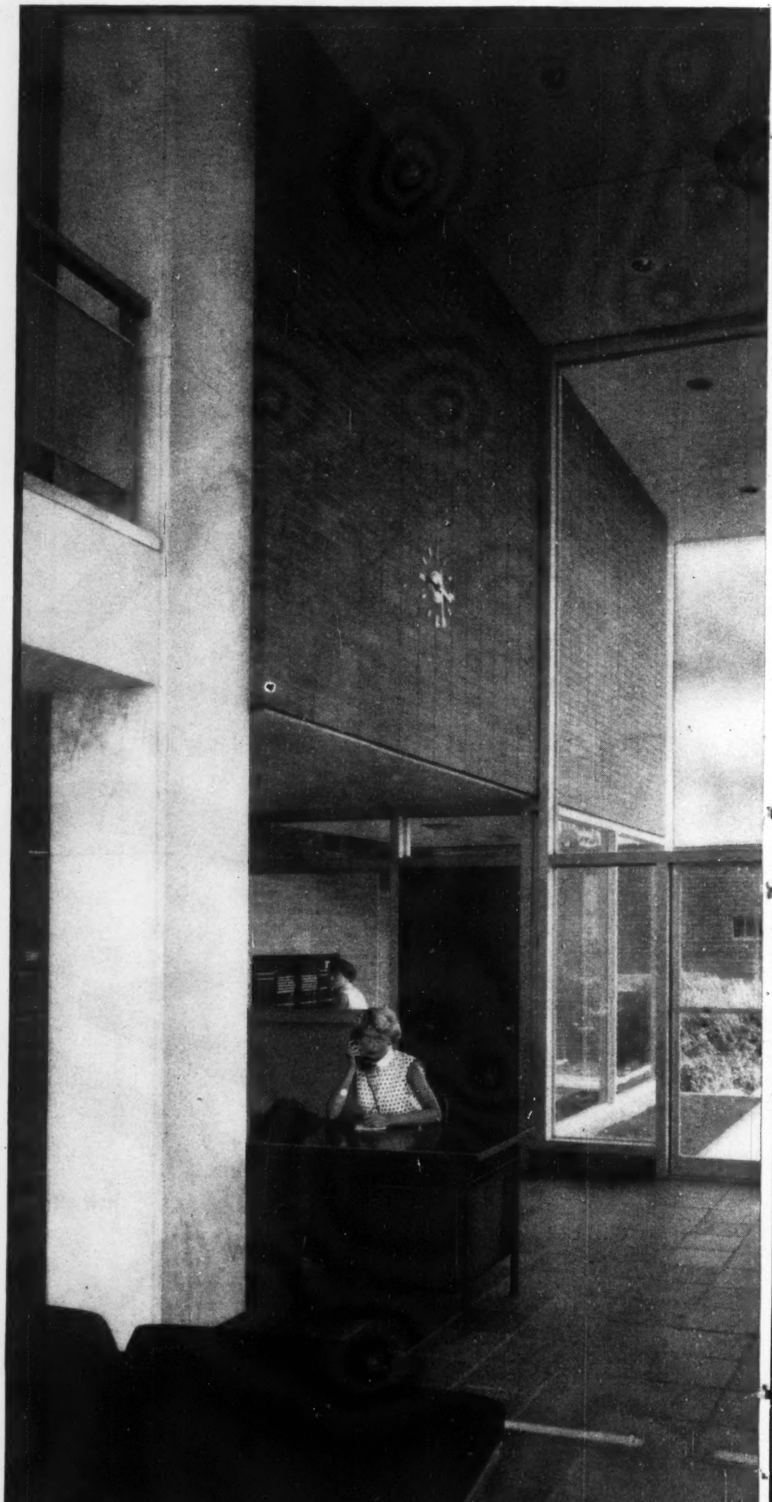
THE people who work in the brand-new Continental Paper Company offices in Ridgefield Park, New Jersey, enjoy some of the "happiest" working weather in America – thanks to the indoor climate planning of Architect L. Freeland Fellgraff.

To provide sensitive, reliable control of the heating-cooling system, Architect Fellgraff called upon Honeywell Customized Temperature Control.

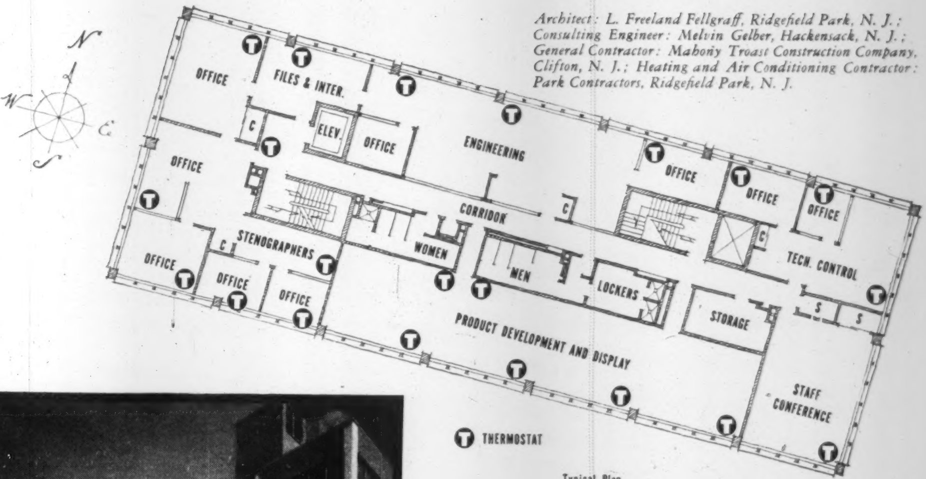
The key word here is "customized." It means that whatever your clients' control requirements, a Honeywell Customized Temperature Control installation *designed to fit the needs of the building and its occupants* is your answer.

With a Honeywell Customized Temperature Control installation such as the one in Continental's new offices, you have *enough* thermostats strategically located to compensate for all exposure, use and occupancy problems. Comfort is assured because the control system is "customized" to the design of the building.

Just as we did for the Continental Paper Company, we can do the job for you and your clients. And only Honeywell can give you *complete* customized service. Because, besides our engineering skill, only Honeywell manufactures *all three* types of control – pneumatic, electric, and electronic.



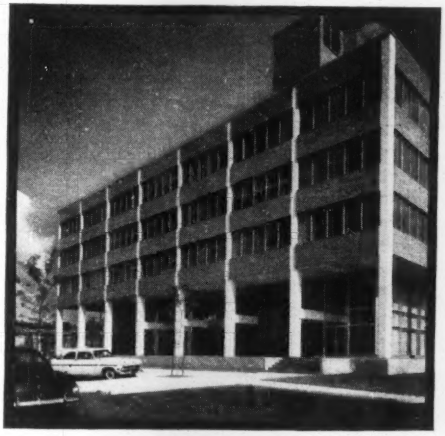
The comfort problems posed by modern buildings are dramatically illustrated by the first floor lobby. Large glass areas heighten the exposure factor, radiate heat in, in summer, heat out in winter. Visitors bring in the outside weather with them. Both these factors, exposure and use, are easily compensated for by the individual Honeywell thermostat in the lobby – and comfort is assured twelve months a year.



Architect: L. Freeland Fellgraff, Ridgefield Park, N. J.; Consulting Engineer: Melvin Gelber, Hackensack, N. J.; General Contractor: Mahony Troast Construction Company, Clifton, N. J.; Heating and Air Conditioning Contractor: Park Contractors, Ridgefield Park, N. J.

Typical Plan

3rd FLOOR PLAN



Another comfort problem arises from the generous use of glass on all four sides of the building. If a cold north wind is blowing, yet the sun is shining warmly through the south windows, the comfort system could get out of balance—if it weren't for Honeywell Customized Temperature Control. Individual thermostats permit control of comfort in individual areas, according to area needs.

A separate thermostat in the staff conference room provides the individual control needed to keep the room comfortable under varying conditions. When a conference is small, more heat (or less cooling) is needed for comfort. For a large conference, less heat (or more cooling). Honeywell Customized Temperature Control takes this into account, keeps the conference room comfortable at all times in any kind of weather.

For comfortable, even temperature in new or existing buildings—of any size—specify Honeywell Customized Temperature Control

Whether it's a factory, motel, hospital—any building of any size—new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems. You can give your clients more comfort and efficiency, and they'll save fuel, too.

For full facts on Honeywell Customized Temperature Control, call your local Honeywell office. Or mail the coupon today.

William J. Alford III, executive vice-president, Continental Paper Co., says:

"Perfect indoor working conditions were a major requirement of our general administrative quarters. We are pleased with the excellent combination of appearance, comfort and functional efficiency. To help achieve this we turned to Honeywell Customized Temperature Control."

MINNEAPOLIS Honeywell

First in Controls

112 OFFICES ACROSS THE NATION

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Dept. HA-11-213 Minneapolis 8, Minnesota

Gentlemen:

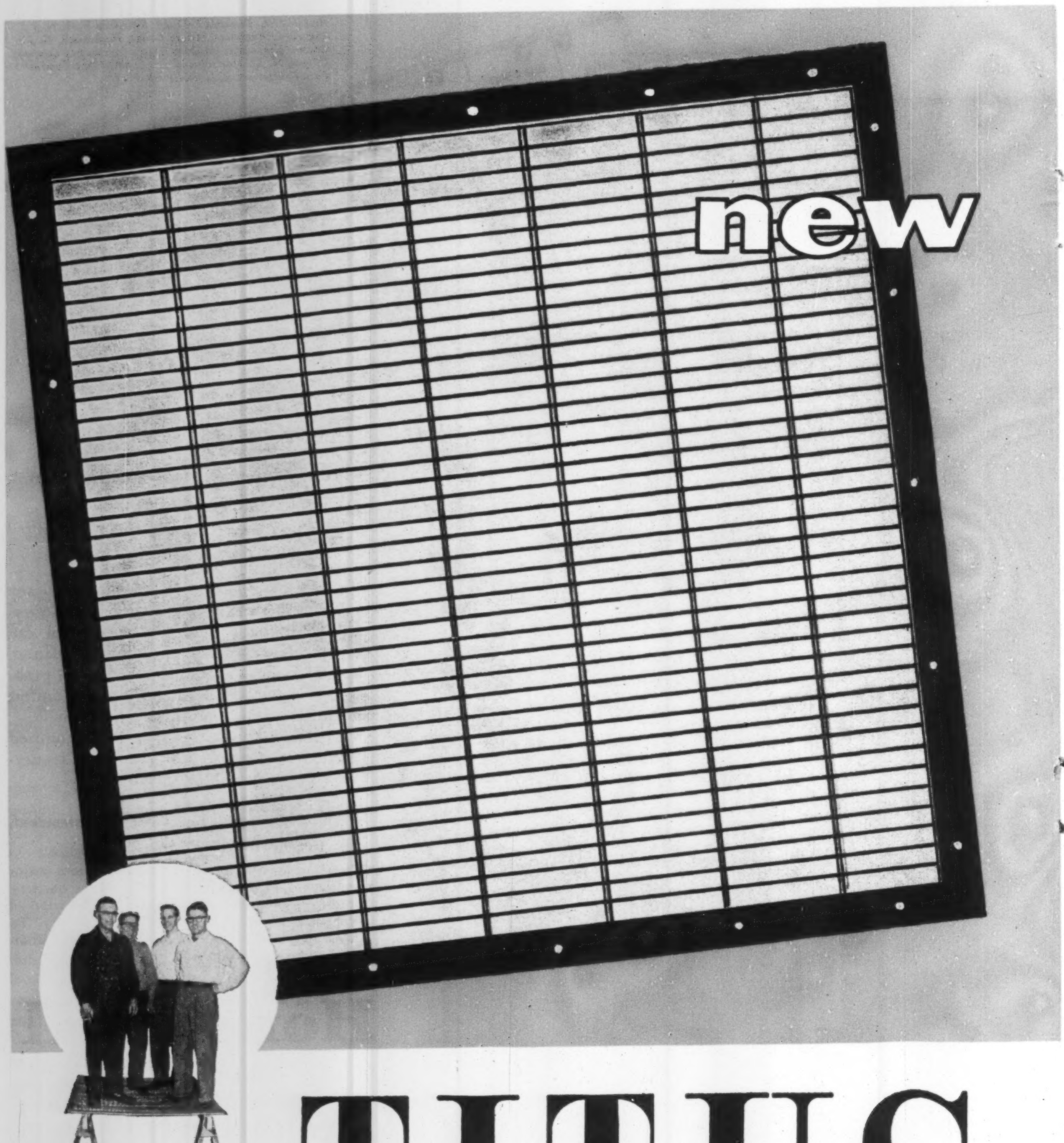
I'm interested in learning more about Honeywell Customized Temperature Control.

Name ____________________

Firm Name ____________________

Address ____________________

City __________ *Zone* ____ *State* __________



● MORE STRENGTH PER SQUARE INCH. 48" x 48" TITUS GYMNASIUM GRILLE supports the combined weight of 4 Titus factory workers.

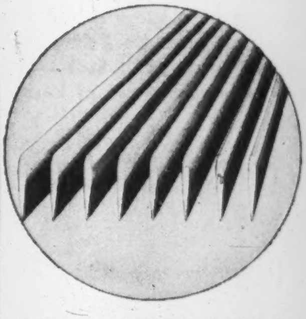
designed by TITUS

Gymnasium Grille

Here's a grille that's been especially customed for school and institutional application. It features *special built-in durability* to withstand gymnasium use and abuse. Made to give long efficient service under the most rugged conditions of bouncing basketballs, baseballs, jarring kicks, and bumps. Has smooth contours, no sharp corners or points. Is safety approved for school use. *Is simply so rugged it stops damage and replacement costs.*

Clean cut, compact, created to blend with the lines of modern school architecture. Available as grille face only (Model G-1) or grille face with attached volume controller (Model G-2).

The Volume Controller features the famous solid section, extruded aluminum, streamlined Airfoil louvers. Noise and turbulence are cut to a minimum. At the same time, perfect, draft-free air distribution is assured.



• MORE AIR CONTROL PER SQUARE INCH. Close up view of *Airfoil* volume control louvers. Each blade is individually adjustable. Concealed louver support eliminates mullions and butied construction.

● 14 GAUGE ROUND EDGED FLAT WIRE STEEL BLADES ● VERTICAL STEEL SUPPORT BARS PLACED ON 6 INCH CENTERS ● 16 GAUGE STEEL EXTRA WIDE BORDER FOR EASY MOUNTING ● STANDARD GRADE PRIMER COAT FINISH.

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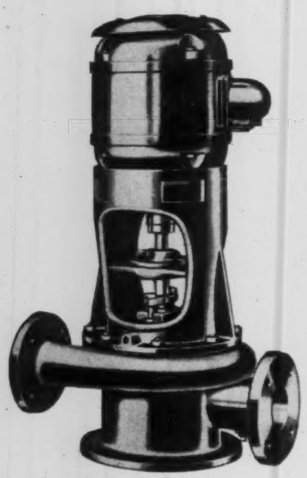
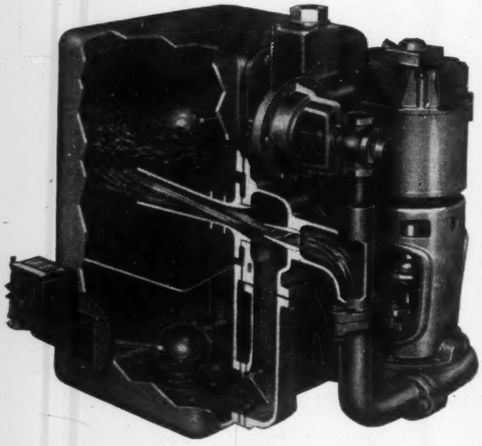
Contractors who recommend Wheeler-Economy Heating Pumps are offering standard, acceptable, equipment at moderate cost. They and the building owners and managers they serve have appreciated "Economy" since 1914. Built into the Wheeler-Economy line is forty one years of heating pump experience.

You install Wheeler-Economy with the peace of mind that you do not have to go back to a job for costly service adjustments. The low first cost, long wear and low maintenance with Wheeler-Economy Heating Pumps help you maintain your reputation for good work. Write for the latest 30 page catalog (H-1152).



TYPE SCV

TYPE VV



TYPE SCC

WHEELER-ECONOMY HOT WATER CIRCULATING PUMPS

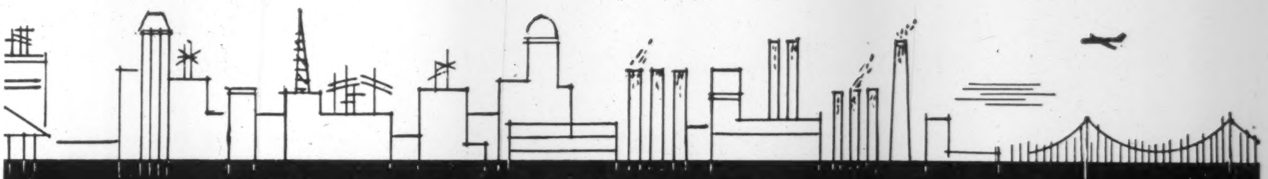
Type SCV — Vertical direct connected centrifugal. Sizes 1 in. to 3 in. Up to 500 gpm. 1150 to 3450 rpm. Heads to 225 ft.

Type SCC — Close-coupled vertical or horizontal mounted. Sizes ¾" and 1¼". Up to 100 gpm. 3450 rpm. Heads to 120 ft.

WHEELER-ECONOMY VACUUM PUMPS

Type VV — Vertical. For operating between 3 and 12 inches vacuum. Discharge pressures to 150 lb. sq. in. EDR 2500 to 15,000 sq. ft. Single and duplex units. Also available in Special Capacities.

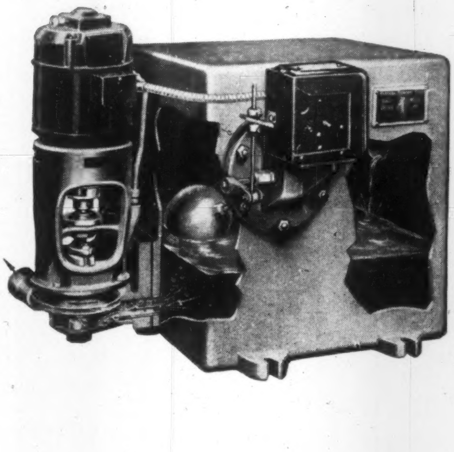
Type SVA — Horizontal. For operating between 3 and 12 inches vacuum. Discharge pressures to 150 lb. sq. in. EDR 20,000 to 100,000 sq. ft. Single and duplex units. Also available in Special Capacities.



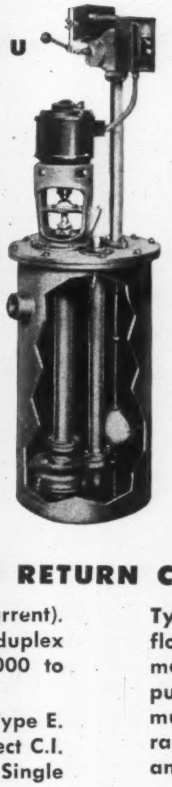
AT MODERATE COST...

HEATING PUMPS

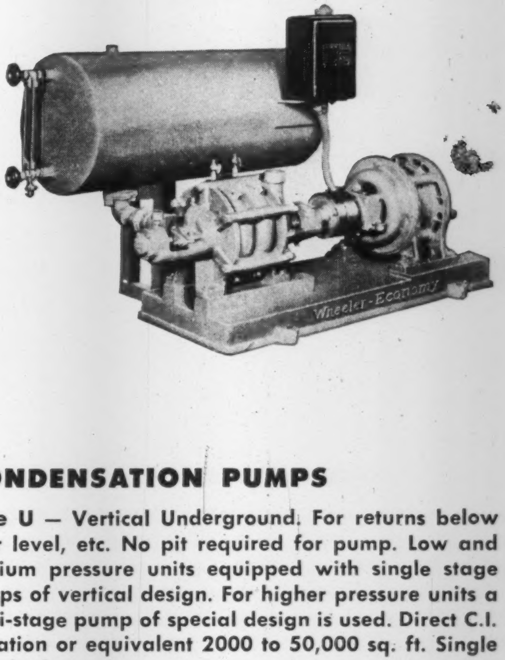
TYPE E & EC



TYPE U



TYPE B & C



WHEELER-ECONOMY RETURN CONDENSATION PUMPS

Type E — 1750 rpm. (1450 rpm at 50 cycle current). Flexible coupled. Quiet operation. Single and duplex units. Direct C.I. radiation or equivalent: 1000 to 65,000 sq. ft.

Type EC — For same or higher pressure than Type E. 3450 rpm. (2880 rpm for 50 cycle current). Direct C.I. radiation or equivalent 1000 to 65,000 sq. ft. Single and duplex units.

Type C — Multi-stage for pressures to 175 lbs. 3600 rpm 60 cycle. Identical to Type B except for higher speed operation.

Type G — Horizontal Return Condensation Pump — Single suction, single stage for medium and high pressures. 1800 to 3450 rpm.

Type U — Vertical Underground. For returns below floor level, etc. No pit required for pump. Low and medium pressure units equipped with single stage pumps of vertical design. For higher pressure units a multi-stage pump of special design is used. Direct C.I. radiation or equivalent 2000 to 50,000 sq. ft. Single and duplex units.

Type MR — Close-coupled, low cost Pump for low pressure steam heating systems. Capacities to 65,000 sq. ft. EDR. Single and Duplex Units.

Type B — Horizontal Return Condensation Pump — multi-stage type for pressures to 150 lbs. 1750 rpm. Quiet operation. Direct C.I. radiation or equivalent, 6000 to 65,000 sq. ft.

WE-405

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration
High Vacuum Process Equipment • Micro-Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery

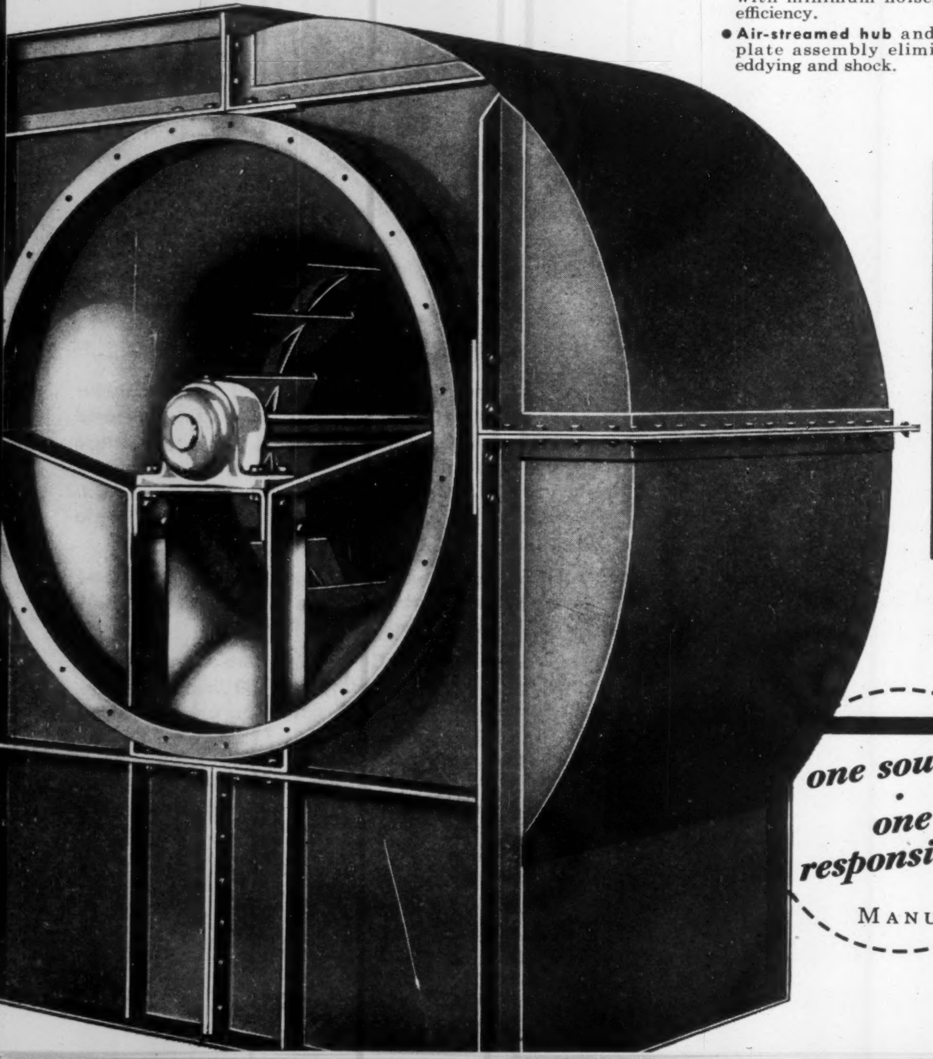
Trane Fans and Coils have more features that give you

Greater efficiency . . . compactness in your built-up

Handle bigger jobs with more compact equipment . . . get greater reliability, too!

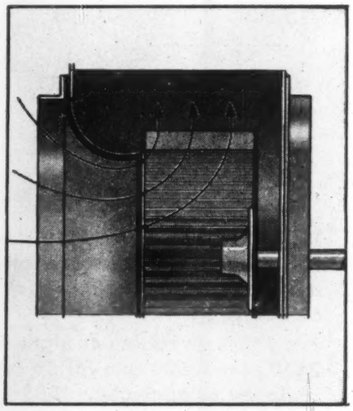
The efficiency features of TRANE Fans and Coils can make a *big* difference in your built-up systems! For example, the TRANE Delta-Flo Fin and mechanical fin-to-tube bond not only give you a more *efficient* coil, but actually form a stronger, more rigid unit than heretofore possible. And even that is only part of the story.

TRANE Centrifugal Fans available in Class I and II, BI types in all sizes through 109", FC types through 89". Utility fans 4" through 30". Propeller fans 10" through 48".



Compare Trane with any other fans

- **True non-overloading** power characteristics, moderate rotative speeds.
- **Special housing** and outlet shapes handle large volumes with minimum noise, high efficiency.
- **Air-streamed hub** and back plate assembly eliminates eddying and shock.
- **Fan wheel balanced** dynamically and statically with electronic balancing equipment.
- **Rugged housing** of lock-seam construction (small fans), welded construction (large fans) resists damage.
- **Proved performance** backed by over a quarter of a century of fan building experience.



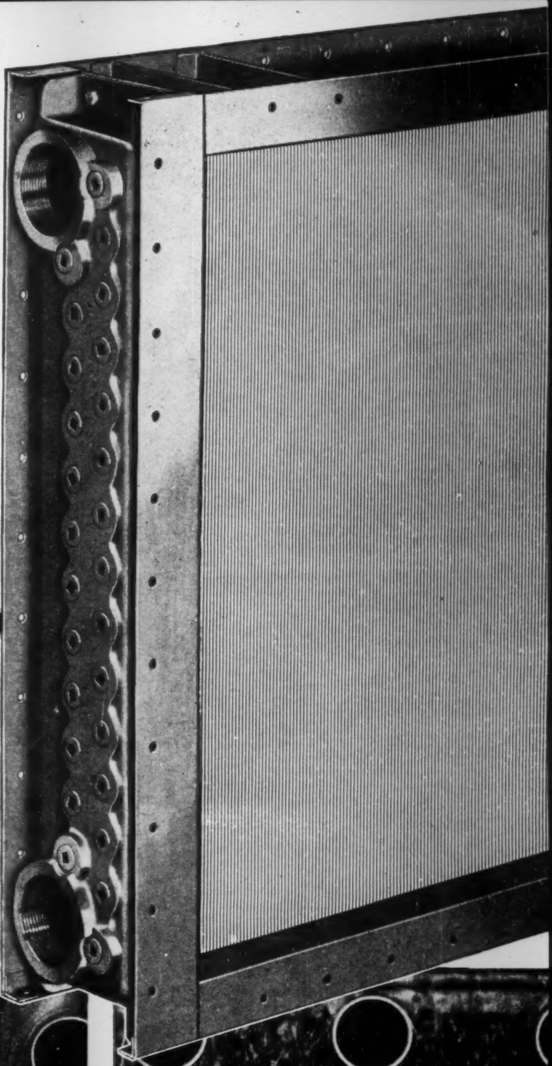
Streamlined inlet cone distributes air evenly in fan wheel without noisy turbulence. Permits fan to operate at high efficiency with low noise level.

one source • one responsibility

Install

MANUFACTURING ENGINEERS

The Trane Company,

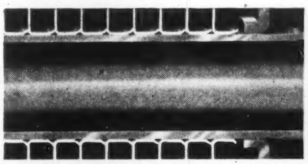


durability . . . systems

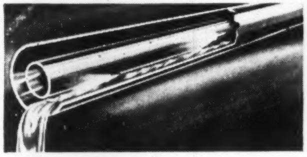
Every TRANE feature—from the accurately streamlined fan inlet to the exclusive kinetic orifice—has been *proved in actual application*. You know you can count on TRANE Fans and Coils for efficiency, durability and compactness *before* you order! For details see your nearest TRANE Sales Office or write TRANE, La Crosse, Wis.

Compare Trane with any other coils

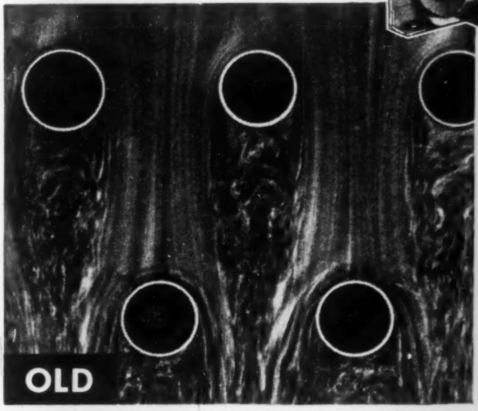
- **Accurate ratings** proved by over twenty-five years of field and laboratory testing.
- **Exclusive dual fin** contact assures high heat transfer, greater strength.
- **Greater rigidity** assured by the formed delta ridge of the new Delta-Flo Fin.
- **Low air friction** of plate type fin offers minimum air resistance.
- **High coil capacity** yet wide fin spacing.
- **25% more effective** use of the fin surface.
- **More uniform heat** transfer over entire surface of the fin.



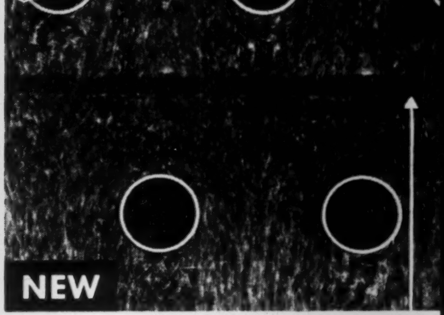
Mechanical fin-to-tube bond is as strong as though fin and tube were one. Wide, flat collar forms generous heat transfer area.

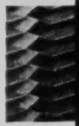


Kinetic orifice on SD coils releases steam in the direction of the condensate flow. Accelerates condensate flow, guards against freezing.



Old plate fin. With flat fin design, turbulence is concentrated behind each tube as shown by this unretouched laboratory test photo. Since turbulence is concentrated, a large part of the fin area produces little heat transfer.



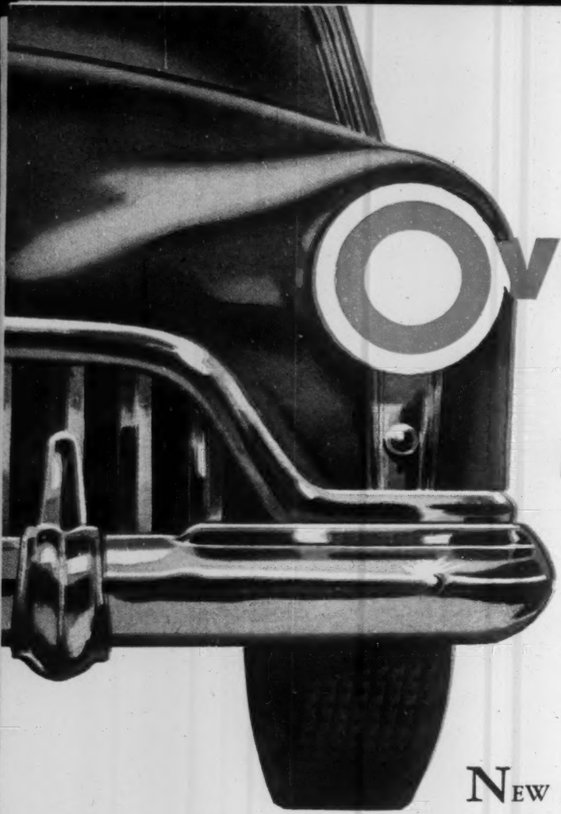


New Delta-Flo Fin. Delta-shaped ridge just ahead of each row of tubes extends turbulence over *entire fin surface* for uniform heat transfer. Unretouched test photo shows how every inch of fin surface contributes to heat transfer.

TRANE Fans and Coils *for efficient built-up systems*

OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

La Crosse, Wis. • Eastern Mfg. Div., Scranton, Pa. • Trane Co. of Canada, Ltd., Toronto • 90 U.S. and 15 Canadian Offices



OVER 21,000,000

MULTI-DUTY AIR FILTERS
IN AUTOMOTIVE
NEW PLANT

NEW MODELS in automotive manufacturing and assembly plants are featuring *clean air* to help insure body finishes free from imperfections; protect precision production operations against the destructive action of dust and dirt; provide better working conditions. To achieve these benefits, plant ventilation systems are being installed that require the automatic, high efficiency cleaning of tremendous air volumes.

Over the past 21 months American Air Filter has supplied for this service Multi-Duty Self-Cleaning Filters totaling over 21,000,000 cubic feet of air per minute. Such overwhelming product acceptance by an industry noted for its progressiveness and exacting standards best tells the story of Multi-Duty's high efficiency and dependable, trouble-free performance.

If you want clean air in large or small volume, automatically and economically, ask your local AAF representative for complete Multi-Duty data. It's the pioneer with the proven record—a record which each year emphasizes the fact that Multi-Duty is America's "most specified" automatic, self-cleaning air filter.

AAF®

herman nelson

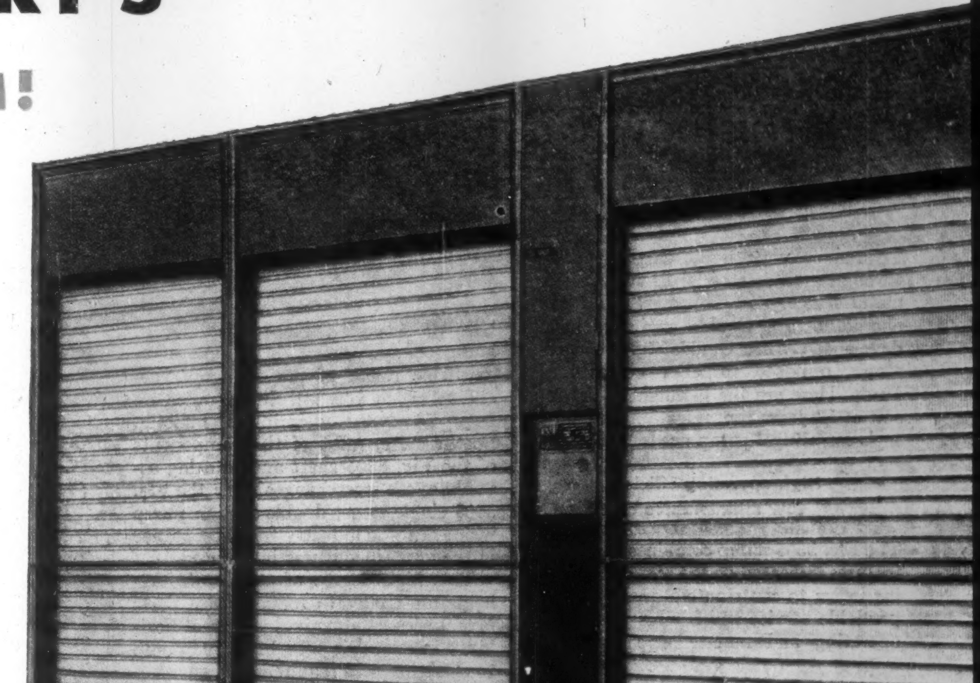
American Air Filter
COMPANY, INC.
373 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

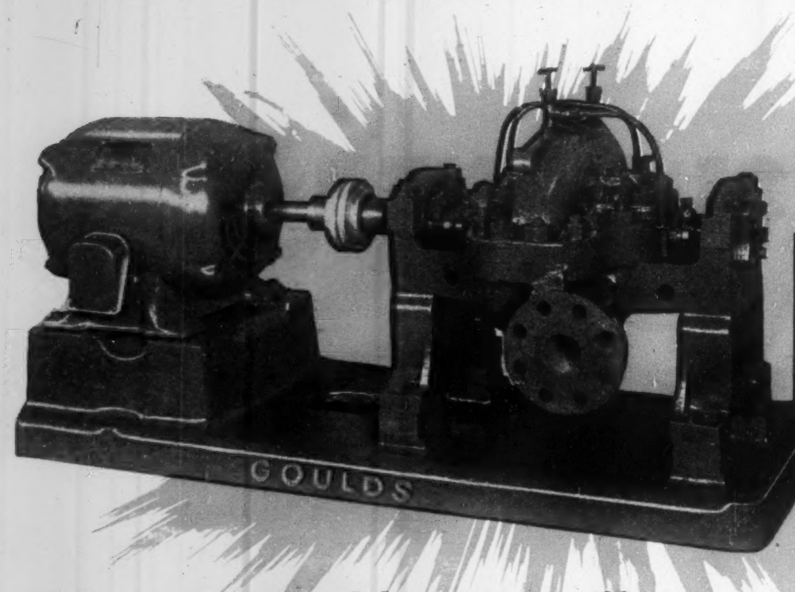
cfm IN 21 MONTHS!

OVERWHELMING FAVORITE

INDUSTRY'S

PROGRAM!





announcing...

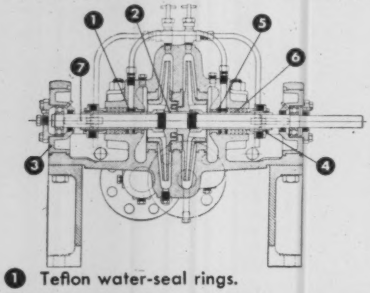
the Goulds Fig. 3305 two-stage, opposed impeller pump for clear liquids. 5 sizes. Capacities to 1200 GPM. Heads to 1000 ft.

This new Goulds pump offers you 5 specific operating and maintenance advantages . . .

To reduce your liquid-handling costs through greater standardization, easier maintenance, and improved operating characteristics, Goulds engineers have developed the *new* Goulds Fig. 3305 two-stage, opposed impeller centrifugal pump. Here are the highlights—the result of 50 years concentration on industry's centrifugal pump needs.

1 High operating efficiency, low maintenance cost

The Fig. 3305 pump combines the seven features indicated on the sectional drawing below to contribute a quality of dependable service which adds up to true operating and maintenance economy.



① Teflon water-seal rings.
② Stainless steel impeller key.
③ Bearing housing sealed against moisture and dirt.
④ Cowl-type glands suitable for use with quenching liquids.
⑤ Renewable stuffing box bushings.
⑥ Die-formed stuffing box packing.
⑦ Corrosion-resistant gland bolts.

2 Reduces your spare parts inventory

Only two shaft and rotating parts assemblies provide for 5 pump sizes and 10 pump combinations. This means a remarkable range of parts interchangeability which you will find detailed on page 7 of the descriptive bulletin. Furthermore, most of the components of the Fig. 3305 shaft and rotating assemblies are interchangeable in the Fig. 3405 single-stage, double-suction pump which has won industry-wide acceptance in the year since it was introduced.

This high degree of standardization helps materially to reduce spare parts inventories. It also gives you great flexibility in adapting your Fig. 3305 pump to changing field requirements.

3 Saves space

The short bearing span of Fig. 3305 pumps means considerable saving in floor space—as much as 50% in some comparisons with conventional designs of comparable capacity and head.

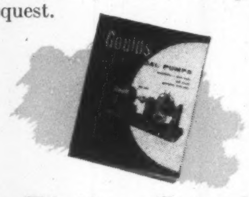
4 Stuffing box to match your requirements

You can choose either a conventional stuffing box with gland or a mechanical seal, according to your need. And you can easily change from one to the other at any time.

5 Simple to change rotation

A patented locking device makes it easy to change the rotation of this pump from right-hand to left-hand or vice versa *in the field and without additional parts.*

Before you select another pump for handling clear liquids at rates up to 1200 GPM and heads to 1000 ft., be sure you have the detailed cost-advantage story of Goulds new Fig. 3305 pump. We'll send you descriptive bulletin—promptly on request.



Get the complete story—This 12-page illustrated Bulletin No. 722.6, covers the new Goulds Fig. 3305 pump completely. It gives specifications, interchangeability tables, performance curves, dimensions.

MEMBER
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Goulds PUMPS INC.
Seneca Falls
New York

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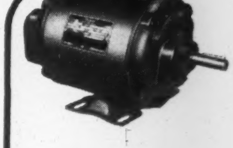
Wagner®
ELECTRIC MOTORS
...the choice of leaders in industry
MOTOR DRIVEN TOOLS
REFRIGERATORS
AIR CONDITIONERS
WATER PUMPS

for single-phase motor applications Wagner Type RK is the Right Kind of motor to use...

Wagner capacitor-start induction motors are the *right kind* of motors to use for most single-phase applications. They have become first choice of many leading manufacturers of air conditioners, refrigerators, freezers, water pumps, and motor-driven tools, and are used in many other similar fractional or integral horsepower applications.

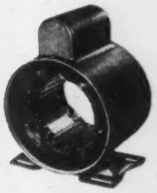
These motors offer low maintenance cost—only a minimum of servicing is required—and they give many years of reliable service with unusual freedom from vibration and noise.

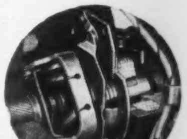
Pictured above is the Wagner Type RK, resilient-mounted capacitor-start induction motor in the new 56 frame that is used for ⅓, ½ and ¾ hp ratings. Smaller fractional ratings, and integral sizes from 1 through 5 hp, are also available.



Wagner rigid base Type RK motor, in the new 56 frame size. The formed steel base is securely welded to the rolled steel frame to produce a strong, rigid mount that will not get out of alignment.

Frames for these motors are made of thick rolled steel, with machined beads which accurately position the end plates. The frames have no openings, and are treated inside and out to prevent rusting.





These motors are equipped with the Wagner quick-break switch that disconnects the starting winding and capacitor from the line when the motor approaches operating speed. It operates over a million times without trouble.

Wagner Electric Corporation
EST. WE 1891

WAGNER ELECTRIC CORPORATION
6370 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

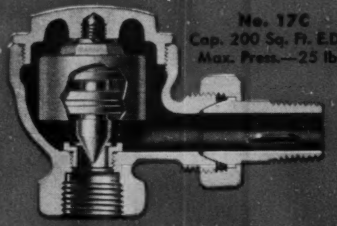
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

M54-15

HOFFMAN STEAM TRAPS

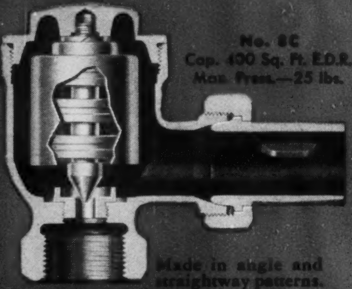
FOR LOW, MEDIUM and HIGH PRESSURES

LOW PRESSURE TRAPS



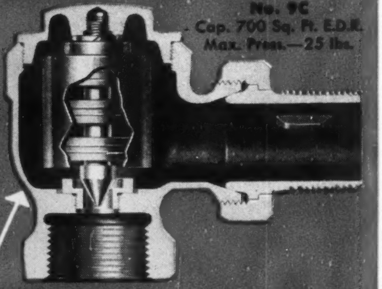
No. 17C
Cap. 200 Sq. Ft. E.D.R.
Max. Press.—25 lbs.

Made in angle, swivel and vertical patterns. ½" pipe conn. Thermostat and seat are renewable. Non-corrosive alloy.



No. 8C
Cap. 400 Sq. Ft. E.D.R.
Max. Press.—25 lbs.

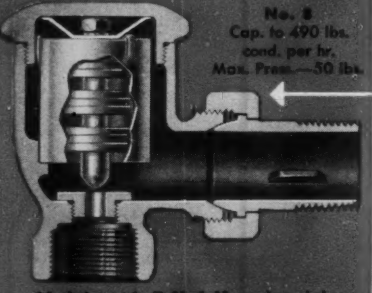
Made in angle and straightway patterns. ¾" pipe conn. Thermostat and seat are renewable. Non-corrosive alloy.



No. 9C
Cap. 700 Sq. Ft. E.D.R.
Max. Press.—25 lbs.

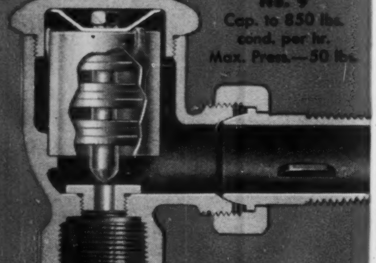
Made in angle pattern only. 1" pipe conn. Thermostat and seat are renewable. Non-corrosive alloy.

MEDIUM PRESSURE TRAPS



No. 8
Cap. to 490 lbs. cond. per hr.
Max. Press.—50 lbs.

Madeinangle, R.H., L.H., and straightway patterns. ½" x ½" and ⅜" x ⅜" sizes. Thermostat and seat are renewable. Non-corrosive alloy.



No. 9
Cap. to 850 lbs. cond. per hr.
Max. Press.—50 lbs.

Made in angle pattern only. ¾" x ¾" and 1" x 1" sizes. Thermostat and seat are renewable. Non-corrosive alloy.

FREE CATALOG

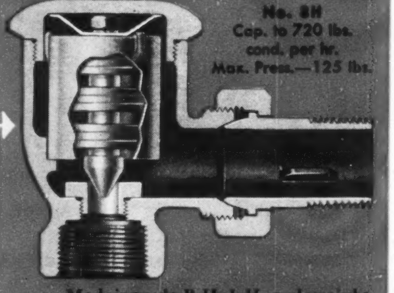
REPAIR PARTS

HOFFMAN
THERMOSTATIC TRAPS
REPAIR PARTS CATALOG

Here is your quick accurate guide to selection of parts needed for the profitable repair or replacement of Hoffman Thermostatic Traps. Includes listing of parts for discontinued series. Write for your free copy today.

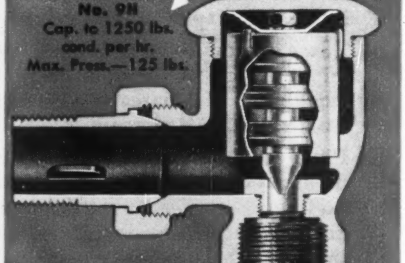
Hoffman offers a complete line of Low, Medium and High Pressure Thermostatic Traps with uniform guarantee of quality and precision workmanship. A full range of sizes and capacities assures you the correct trap for service with radiation, dryers, sterilizers, mangles, cookers and similar uses. Body, cap, nut and tail piece are of high quality brass. Other features of design contribute to long life.

HIGH PRESSURE TRAPS



No. 8H
Cap. to 720 lbs. cond. per hr.
Max. Press.—125 lbs.

Madeinangle, R.H., L.H., and straightway patterns. ½" x ½" and ⅜" x ⅜" sizes. Thermostat and seat are renewable. Non-corrosive alloy.



No. 9H
Cap. to 1250 lbs. cond. per hr.
Max. Press.—125 lbs.

Made in angle pattern only. ¾" x ¾" and 1" x 1" sizes. Thermostat and seat are renewable. Non-corrosive alloy.

HOFFMAN STEAM SPECIALTIES

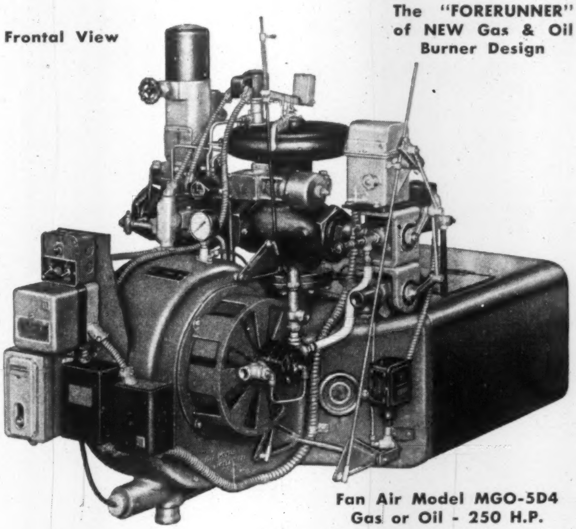
HOFFMAN SPECIALTY MFG. CORP.
VALVES, TRAPS, VACUUM AND CONDENSATION PUMPS, FORCED HOT WATER HEATING SYSTEMS

1001 York St., Indianapolis 7, Ind.
Sold by leading Wholesalers of Heating and Plumbing Equipment

Mettler "FAN-AIR" AUTOMATIC MECHANICAL DRAFT "PACKAGED" GAS BURNERS *and Companion* DUAL FUEL BURNERS

Frontal View

The "FORERUNNER" of NEW Gas & Oil Burner Design

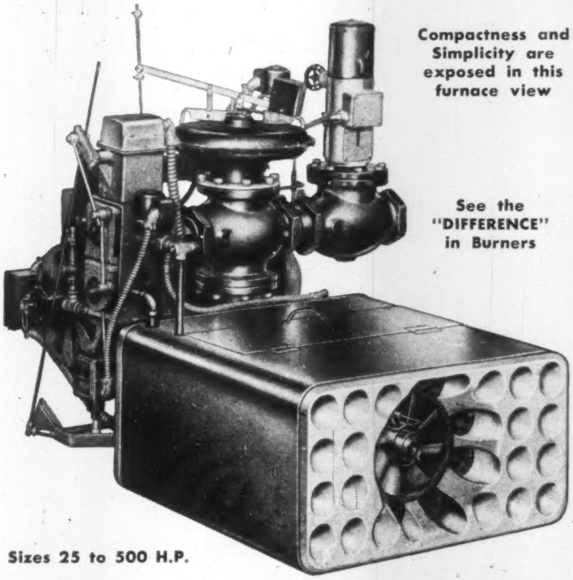


Fan Air Model MGO-5D4 Gas or Oil - 250 H.P.

A fully **automatic mechanical draft burner** employing the ENTRAINED COMBUSTION PRINCIPLE. Operates equally efficiently with any gas or No. 2 to No. 5 Fuel Oil. A "flip of the switch" or automatic remote control changes from Gas to Oil or in reverse. Nothing else like it on the market. Another example of Mettler **Leadership designed to fill the trend and need of the** Gas Industry.

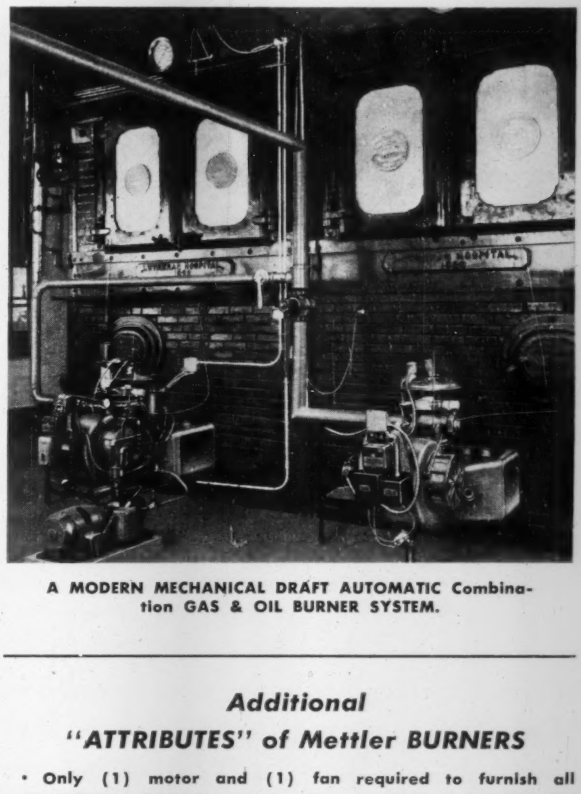
Compactness and Simplicity are exposed in this furnace view

See the "DIFFERENCE" in Burners



Sizes 25 to 500 H.P.

In a modernization program this institution selected Mettler **FAN-AIR** Mechanical Draft Automatic Gas Burners to replace Coal in one boiler initially. Subsequently the adjoining boiler was equipped with the Fan-Air **(MGO) DUAL FUEL BURNER** thus providing increased Safety Factor, greater flexibility with substantial fuel savings and many other accruing benefits from **Gaseous Fuels.**



A MODERN MECHANICAL DRAFT AUTOMATIC Combination GAS & OIL BURNER SYSTEM.

Additional "ATTRIBUTES" of Mettler BURNERS

- **Only (1) motor and (1) fan required to furnish all (100%) of air for burning Gas or Oil fuel. An exclusive Mettler feature.**
- **Requires less stack and furnace suction.**
- **Develops greater capacity from old boilers.**
- **Quiet performance and higher turndown ratio.**
- **Fully automatic "packaged" and tested prior to shipment resulting in lower installation costs.**

ALL BUILT ON THE *"Entrained Combustion"* PRINCIPLE • THE "FAN-AIR" MGO SERIES IS WORTHY OF YOUR SPONSORSHIP • PROMPT SHIPMENTS ASSURED • WRITE FOR DETAILS.

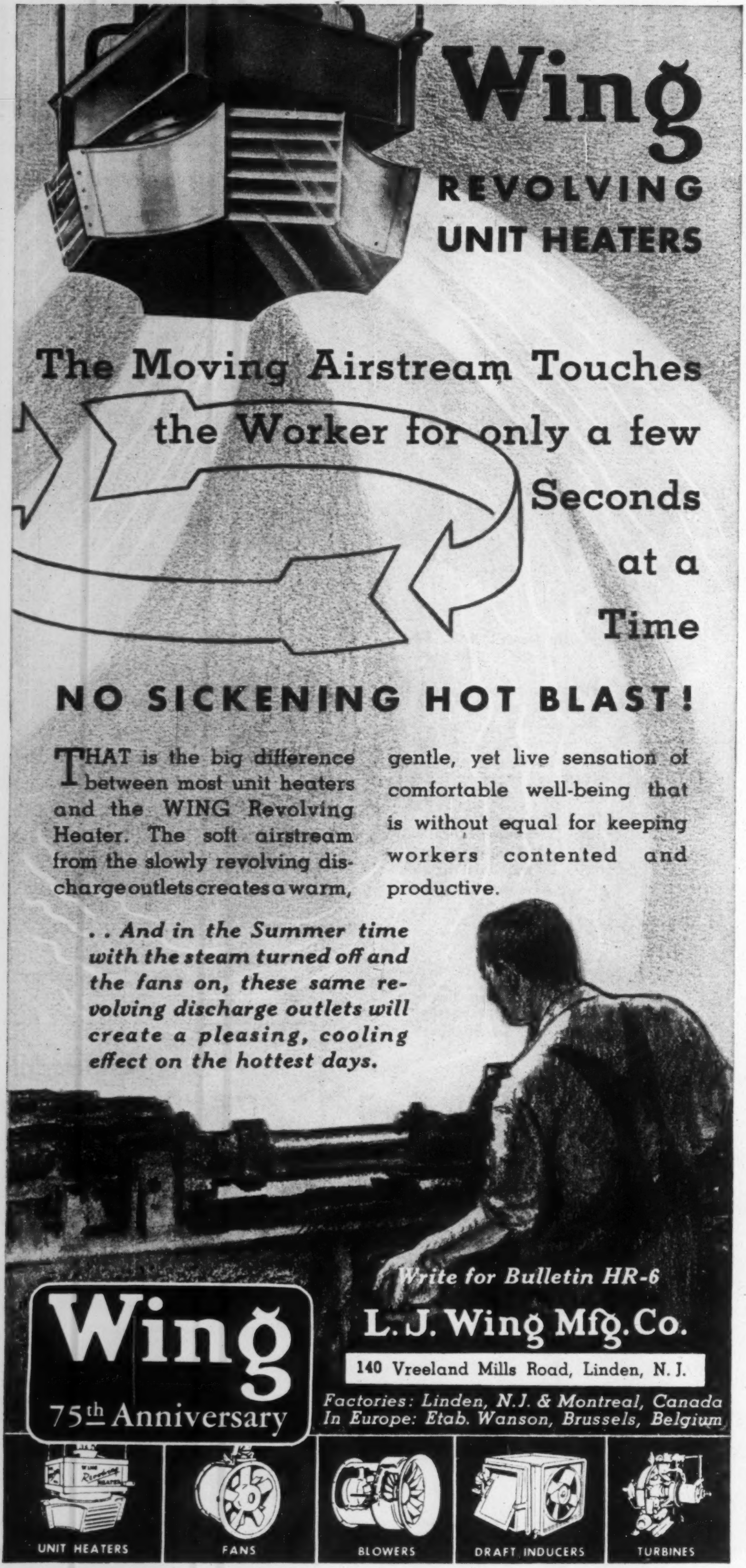
EXPERTO CREDE*

4366 WORTH STREET

THE METTLER CO. INC.

LOS ANGELES 63 CALIFORNIA

***TRUST ONE WHO HAS HAD EXPERIENCE — A RECOGNIZED TRADEMARK SINCE 1922**



Wing

REVOLVING UNIT HEATERS

The Moving Airstream Touches the Worker for only a few Seconds at a Time

NO SICKENING HOT BLAST!

THAT is the big difference between most unit heaters and the WING Revolving Heater. The soft airstream from the slowly revolving discharge outlets creates a warm, gentle, yet live sensation of comfortable well-being that is without equal for keeping workers contented and productive.

. . And in the Summer time with the steam turned off and the fans on, these same revolving discharge outlets will create a pleasing, cooling effect on the hottest days.

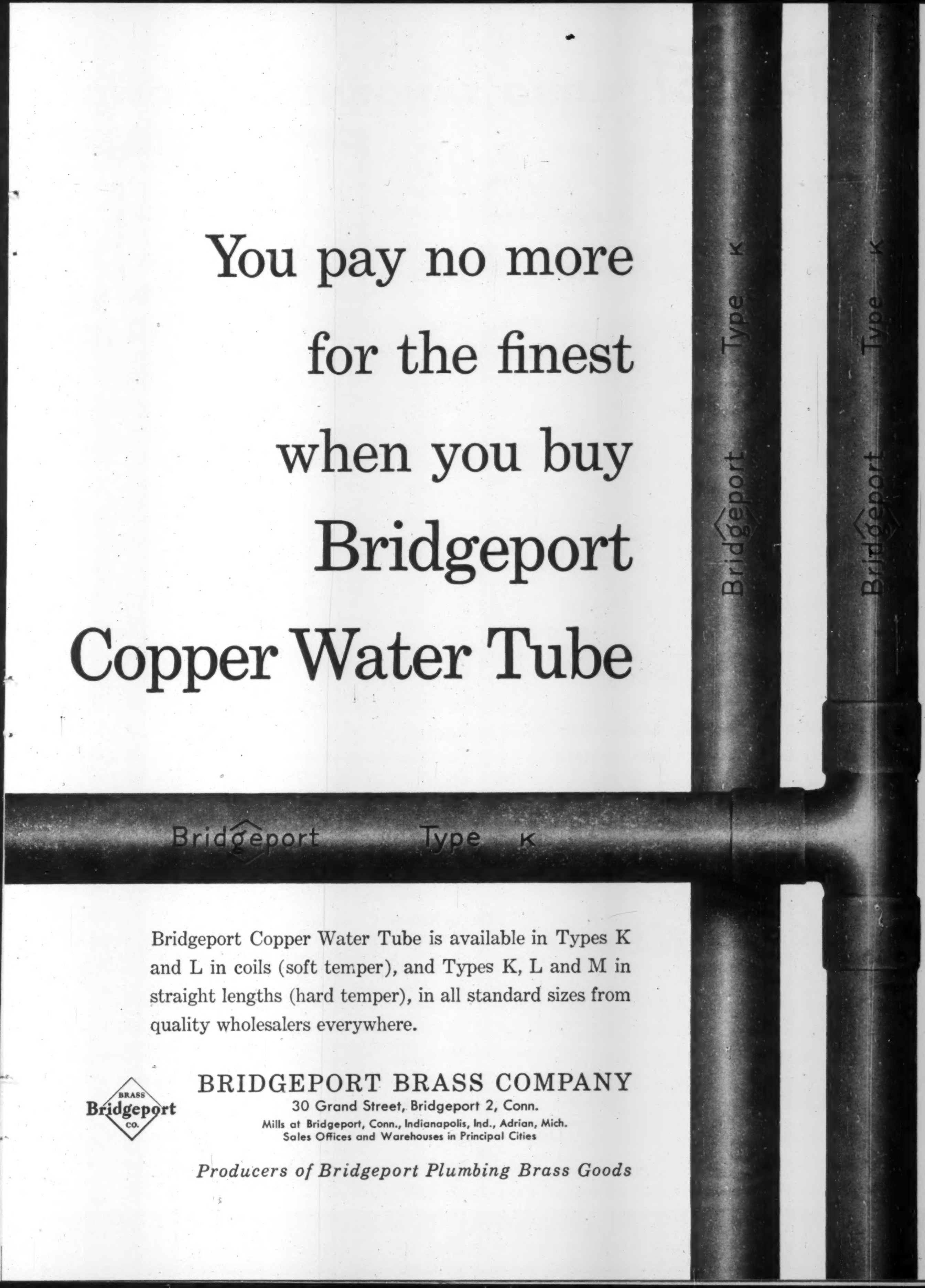
Write for Bulletin HR-6

Wing
75th Anniversary

L. J. Wing Mfg. Co.
140 Vreeland Mills Road, Linden, N. J.

Factories: Linden, N.J. & Montreal, Canada
In Europe: Etab. Wanson, Brussels, Belgium

UNIT HEATERS | FANS | BLOWERS | DRAFT INDUCERS | TURBINES



You pay no more
for the finest
when you buy
Bridgeport
Copper Water Tube

Bridgeport Copper Water Tube is available in Types K and L in coils (soft temper), and Types K, L and M in straight lengths (hard temper), in all standard sizes from quality wholesalers everywhere.

BRASS
Bridgeport
CO.

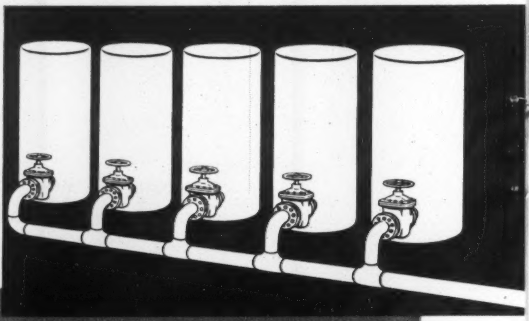
BRIDGEPORT BRASS COMPANY
30 Grand Street, Bridgeport 2, Conn.
Mills at Bridgeport, Conn., Indianapolis, Ind., Adrian, Mich.
Sales Offices and Warehouses in Principal Cities

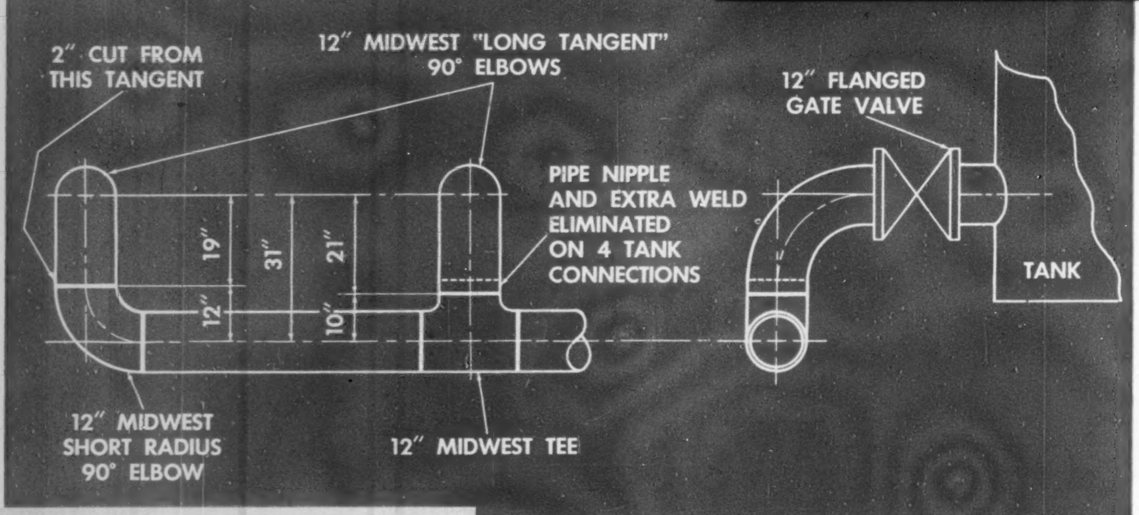
Producers of Bridgeport Plumbing Brass Goods

MIDWEST "LONG TANGENT" ELBOWS

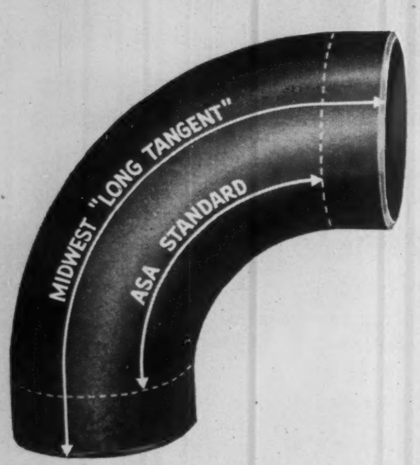
SAVED $156.20

On This Welding Piping




2" CUT FROM THIS TANGENT
12" MIDWEST "LONG TANGENT" 90° ELBOWS
12" FLANGED GATE VALVE
PIPE NIPPLE AND EXTRA WELD ELIMINATED ON 4 TANK CONNECTIONS
19"
31"
21"
12"
10"
TANK
12" MIDWEST SHORT RADIUS 90° ELBOW
12" MIDWEST TEE

MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS


MIDWEST "LONG TANGENT"
ASA STANDARD

The Problem:

To connect the five tanks shown in the sketch at top to a common 12" header.

The Difficulty:

The center-to-outlet dimension of the 4—12" tees is only 10", while the shortest elbow available measures 12" center-to-end, Thus, if standard long radius elbows are used next to the five tank valves, four short nipples and four extra 12" welds would be required.

The Solution:

By using Midwest "Long Tangent" elbows as shown in the blueprint, the expense of the four extra nipples and welds was eliminated at the cost of just one cut! The actual net savings made by "Long Tangent" elbows on this job was $156.20.

Remember—Midwest "Long Tangent" elbows cost no more than regular elbows! For further information, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Missouri

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—50 CHURCH ST. • LOS ANGELES 33—520 ANDERSON ST.
BOSTON 27—426 FIRST ST. • CHICAGO 3—79 WEST MONROE ST.
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6820

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

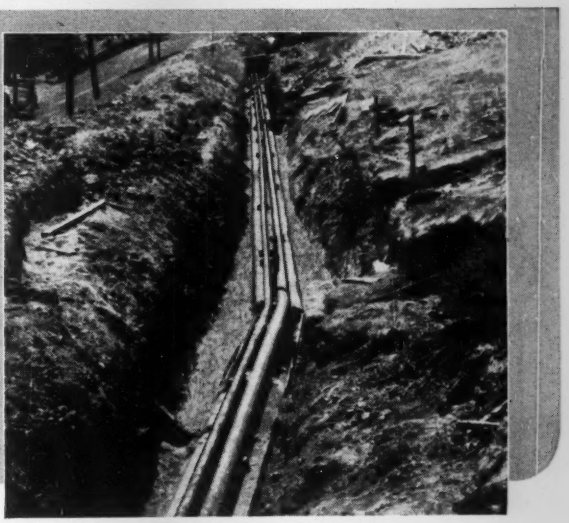
Going Underground?

Here's The
Easier, Faster Low Cost Way To
INSTALL YOUR PIPES *THEN* INSULATE THEM!

WITH

"Z" crete®

THE MODERN MONOLITHIC INSULATION FOR UNDERGROUND HEATED PIPING



Here's the easy, fast, economical way to install —*then insulate*— underground heated piping . . .

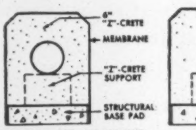
EASIER because the structural concrete base pad provides better working conditions, and because pipes can be welded on or below grade, and placed with no special care or handling.

FASTER because Z-Crete is entirely a field fabrication. Job changes can be effected during job progress. Any size, number, or arrangement of pipes can be placed in one conduit. No pre-formed sections required.

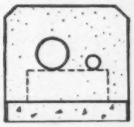
LOW-COST because Z-Crete is poured directly around pipes *after* they are welded and tested, leaving no joints or voids to leak heat. Greater thicknesses of insulation may be provided at less cost with the Z-Crete system.

Z-Crete is a patented process installed by experienced licensed applicators. There is one nearby, ready to serve you. Why not inquire today! For additional Z-Crete specifications, mail coupon below for FREE booklet with complete details.

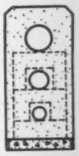
FOR ANY HEATED UNDERGROUND SYSTEM



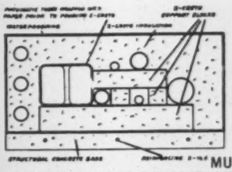
SINGLE PIPE CONDUIT



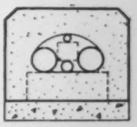
TWO PIPE CONDUIT



PIPE OVER PIPE



MULTIPLE PIPE CONDUIT



MULTIPLE PIPE CONDUIT WITH STEAM TRACER

"Z" crete®

DIVISION

ZONOLITE COMPANY

135 South LaSalle St., Chicago 3, Illinois

Z-Crete is furnished and installed only by licensed applicators of Zonolite Company under U. S. Patent No. 2355966—Canadian Patent No. 439356.

WRITE FOR FREE BOOKLET

Z-Crete Division, Zonolite Company
Dept. H-114, 135 S. LaSalle St., Chicago 3, Ill.

Please rush FREE Z-Crete Booklet with full details and specifications about this easier, faster insulation for underground heated piping.

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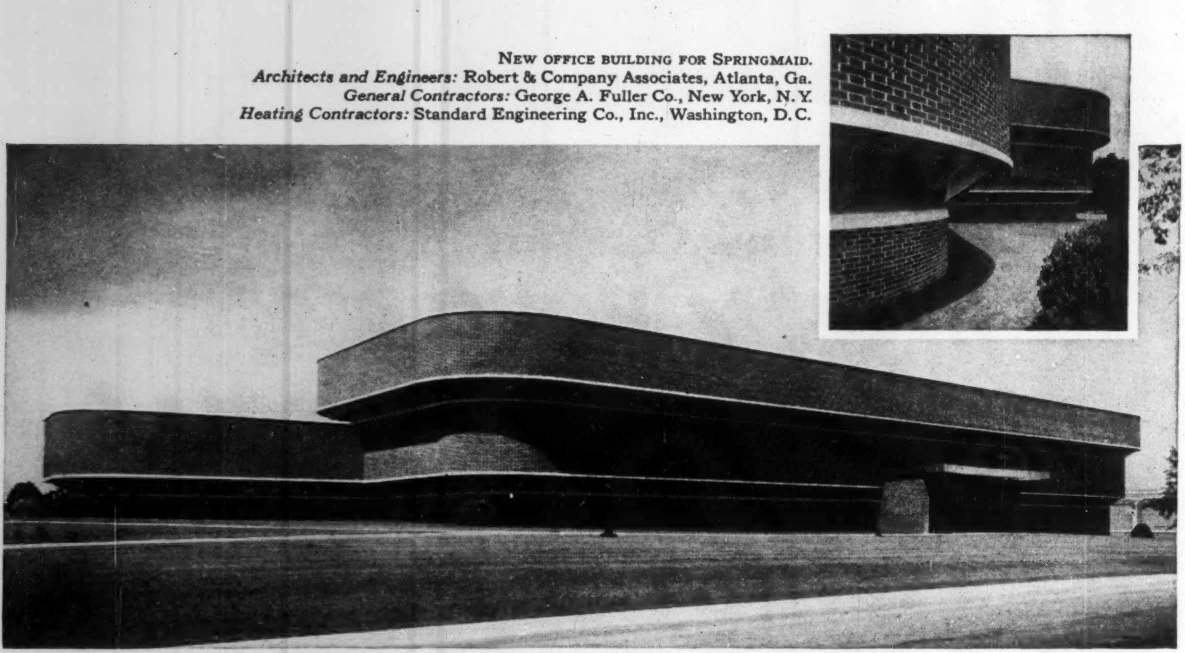
Company..
Address..
City....................................Zone.......State...........................

NEW OFFICE BUILDING FOR SPRINGMAID.
Architects and Engineers: Robert & Company Associates, Atlanta, Ga.
General Contractors: George A. Fuller Co., New York, N. Y.
Heating Contractors: Standard Engineering Co., Inc., Washington, D. C.



SARCOTHERM *Controls Radiant Heating System in Springmaid's Unique Home Office*

SPRINGMAID FABRICS

UPSIDE-DOWN WINDOWS, "floating" ceilings, and radiant heated walls tell the story of Springs Cotton Mills' remarkable new building in Fort Mill, S. C.

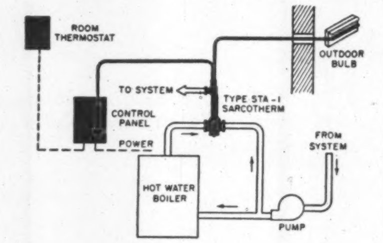
Sarcotherm weather modulated controls were specified for the building's unusual heating system which operates through radiant panels installed in the walls. The system is divided into seven zones, each of which is regulated by a Sarcotherm Indoor-Outdoor control. Thus each zone is assured comfort regardless of location and outside temperature conditions.

Sarcotherm provides a simple, low-cost way of achieving accurate, sensitive control of radiant and hot water heating systems. Coupled to these distinct advantages is Sarcotherm's extensive engineering service which can help you design and install the most efficient and trouble-free system possible.

A Sarcotherm heating engineer will be happy to talk over your next project with you. For complete details on Sarcotherm weather modulated controls contact your nearest Sarcotherm representative, or write direct to Sarcotherm Controls, Inc., Empire State Building, N. Y. 1, N. Y.

SARCOTHERM CONTROLS, Inc.

An Affiliate of SARCO COMPANY, INC.



Typical of the Springmaid installation is this hookup. Proportioning type mixing valve continuously modulates water temperatures.

TAKE ADVANTAGE OF SARCOTHERM'S UNUSUAL ENGINEERING SERVICE

In a Class By Itself—Sarcotherm's engineering service begins with the inception of the job, *carries through* every step of the way.

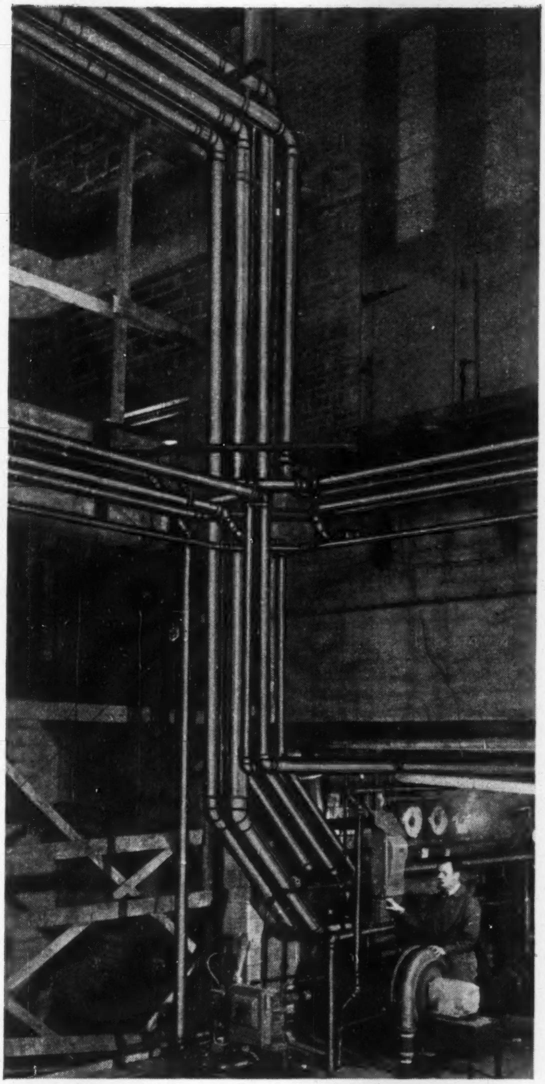
Complete Installation Drawings and Wiring Diagrams—not just general drawings but complete, tailor-made Sarcotherm drawings and diagrams for each individual job.

On-the-Job Help—your contractor gets Sarcotherm's full cooperation and technical assistance backed by many years of specialized experience.

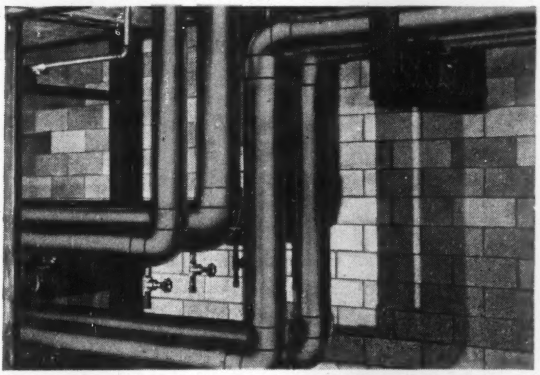
Weather Modulated Controls for Hot Water, Radiant and Steam Heating Systems

6" and 8" Water Mains of Anaconda Copper Tube installed in new hospital

Copper's non-rusting and corrosion-resistant properties assure long piping life, low maintenance costs



BOILER ROOM of new Ste. Justine Hospital, Montreal, Canada. Architect, Joseph Sawyer. Associate architect, Henri S. Labelle. Consulting engineers, Leblanc & Montpetit. Distributor, James Robertson Co., Ltd. All the above firms are located in Montreal, as is the Industrial Plumbing & Heating Co., Ltd. who made the installation.



SHOWN ABOVE are 8" Type K water main, 6" fire main and two 6" hot water lines. Note tubes do not touch steel support. They rest on copper strip welded on U-shape support.

All hot and cold water lines in Montreal's new multi-million-dollar Ste. Justine Hospital are Type "K" Copper Tube. The installation includes 8" tube for the main supply line and 6" tube for the mains serving the hot water system and fire protection lines.

Industrial Plumbing and Heating Co., Ltd., Montreal, who made the installation, has this to say about copper:

"...proved most economical piping material because of complicated layout...made the installation in much less time than it would have taken with pipelines requiring threaded connections...longer lengths meant fewer fittings...solder-type fittings made quickly...easy to handle because of light weight...smaller sizes bent right on the job...able to make connections in close quarters where a threaded assembly would be impossible..."

All these are good reasons why you can make big savings on installation costs when you use ANACONDA Copper Tubes.

Operating costs are less, too. The smooth, rust-free interior surface means lower pumping costs. The ease of dismantling and reassembling copper tube lines to meet changing piping requirements saves money and keeps costly shutdown time to a minimum.

If our Technical Department can be of assistance in helping you solve a piping problem, don't hesitate to call on them. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5447

for copper piping call an

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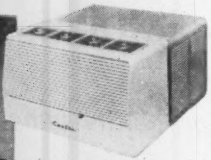
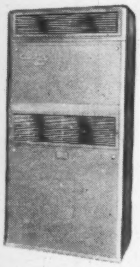
Offers You MORE OPPORTUNITIES

For Sales and Profit



Efficient Room Air Conditioners

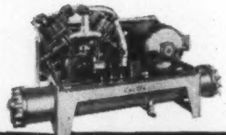


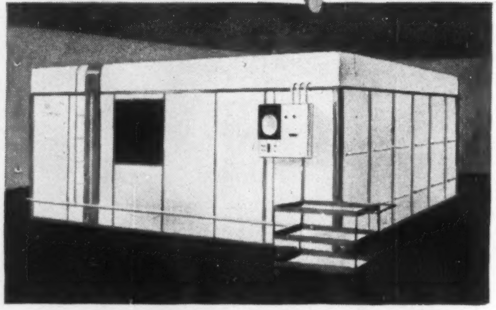
2, 3, 5, 7½, and 10-ton Packaged Units

COOL

JUST A ROOM OR TWO . . .

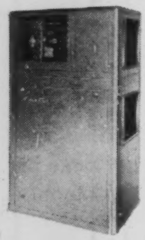
Condensing Units—
15 through 80 tons



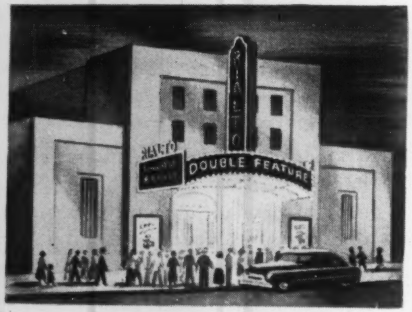


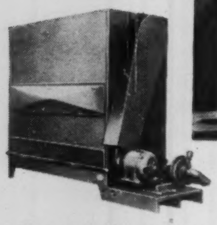
CONTROLLED COOLING FOR PROCESSING . . .

OR COOL AN ENTIRE BUILDING



Residential Combination Heating-Cooling Units

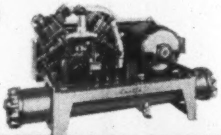


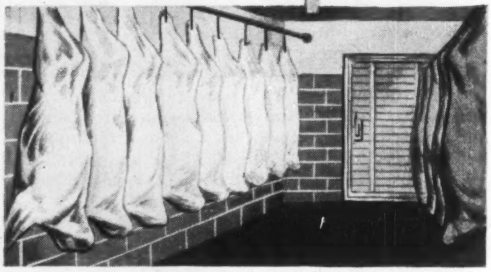


Evaporative Condensers and Cooling Towers

OR REFRIGERATE AN ENTIRE STORAGE ROOM

Condensing Units—
15 through 80 tons





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Go All the Way with Curtis

the company that gives you everything you need to do practically any refrigerating or air conditioning job. Curtis *quality* is your assurance that those jobs will be Right—that customers will be completely satisfied.

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OF SUCCESSFUL MANUFACTURING EXPERIENCE

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keep your coolers from busting

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ALCO

EVAPORATOR
PRESSURE
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They hold evaporator pressures to a predetermined point when the load changes. Available for any size water cooler—from drinking fountains to large industrial installations.

ENGINEERED
for service
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SEE YOUR ALCO WHOLESALER

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Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

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The BEST Distributors in America SELL

READING COPPER TUBE

One of the best ways to judge a product is by the calibre of the distributors who sell it.

We, at Reading, consider it highly significant that America's leading distributors have chosen Reading Copper Tube to sell and recommend. These distributors build their business by handling the finest products — products whose quality and performance they can depend on to uphold their reputation for giving customer satisfaction. Of equal importance to them is service. And they know from experience that Reading's streamlined, shirt sleeve service eliminates delays . . . speeds delivery from factory . . . to distributor . . . to contractor. Next time you need copper tube . . . specify Reading . . . precision product of one of America's largest, completely integrated mills, specializing in the processing of copper tube from basic metal to finished tubing . . . and sold by America's best distributors.

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A USEFUL GUIDE FOR
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Reading's New 32 page guide for Copper Water Tube, Copper Refrigeration Tube, and Red Brass and Copper Pipe is now available. Write for your free copy today.

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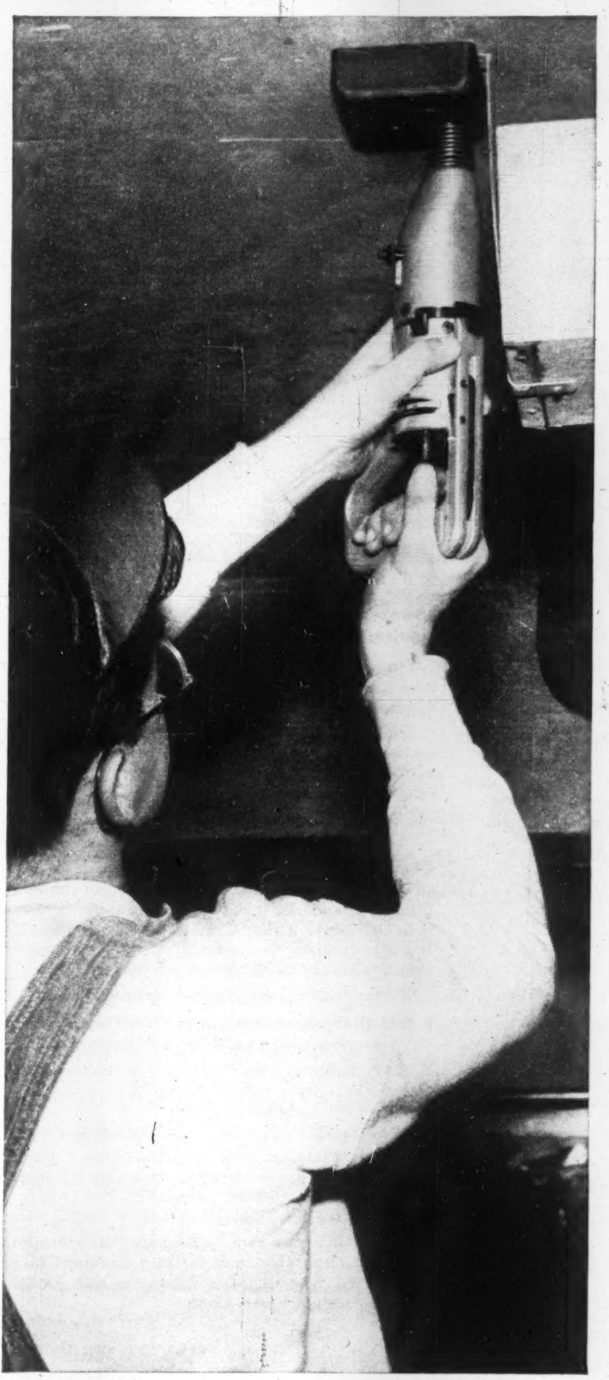
On duct anchoring jobs...here's how you save with the



Overhead work is fast and easy with the Remington Stud Driver. It weighs only 6 lbs.—requires no outside power source.

REMINGTON STUD DRIVER

YOU SAVE TIME. With the Remington Stud Driver, you can set up to 5 fastening studs per minute in steel or concrete—each stud anchored solidly and permanently. This speed results from the tool's source of power, a 32 caliber cartridge. And its light weight (6 lbs.) and compact size make overhead duct work easier, less tiring.

YOU SAVE MONEY. Savings as high as 80% have been reported with the Stud Driver over old-style fastening methods. That's important with today's rising costs and means *you can bid lower, get more jobs!* And remember, the tool can be used on a wide variety of fastening jobs in addition to ducts . . . wood plates, pipe hangers, conduit and pipe clips and many others.

SEND COUPON BELOW. It will bring you our illustrated booklet on the Remington Stud Driver and show you how you can cut your fastening costs.

TYPICAL QUESTION FROM A CONTRACTOR

Q. *You said the tool pays for itself in a recent ad. About how many fastenings does it take to pay for it?*

A. *Purchase of a Remington Stud Driver, based on gross savings, can be justified with only a few hundred fastenings to concrete.*

MAIL THIS COUPON TODAY

Industrial Sales Division, Dept. HPAC-11
Remington Arms Company, Inc.
Bridgeport 2, Connecticut

Please send me my free copy of the new booklet showing how I can cut my fastening costs.

*Name*______________________________

*Position*____________________________

*Firm*______________________________

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*City*____________________ *State*________

"If It's Remington—It's Right!"

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Listed & Approved by Underwriters' Laboratories, Inc.

NO WAITING FOR PUMPS AND CONDENSERS...

Popular sizes carried in stock!

SERIES 1531 *UNI-BUILT* PUMP
SERIES 1522 *UNI-BUILT* PUMP
MODEL CFG SHELL AND COIL CONDENSER
MODEL CRF STRAIGHT TUBE CONDENSER

Specially designed pumps for air conditioning and refrigeration applications

For your convenience, a stock of most commonly used sizes of B & G Series 1522 and 1531 Pumps is maintained at the factory for immediate shipment.

The leak-proof "Remite" Mechanical Seal alone makes these pumps a *buy!* This new-type Seal is harder than glass—wear-proof, corrosion-resistant. It's self-lubricating and eliminates leakage through the packing gland—assures trouble-free operation.

Smooth running...quiet!

Oversize bearings hold the shaft in alignment for smooth, quiet performance...balancing of the impeller prevents shaft vibration and seal failure. B & G Series 1522 and 1531 Pumps kept in stock at the factory are bronze-fitted only, but are available as all-iron, all-bronze or stainless steel units.

With all these advantages, prices are competitive.

B & G Condensers for replacement or original equipment in smaller installations

B & G quality in two moderately priced refrigeration condensers...built in popular sizes and stocked for immediate shipment.

Model CFG is a shell and coil condenser with extended surface for rapid transfer of heat. Correct designing and sturdy construction assure efficient, dependable service. Built to ASME Code requirements and labeled "UM".

Model CRF is an extended surface, straight tube unit with removable head for easy cleaning. It is constructed and stamped in accordance with ASME Unfired Pressure Vessel Code.

Send for complete information on B & G Stock Pumps and Condensers

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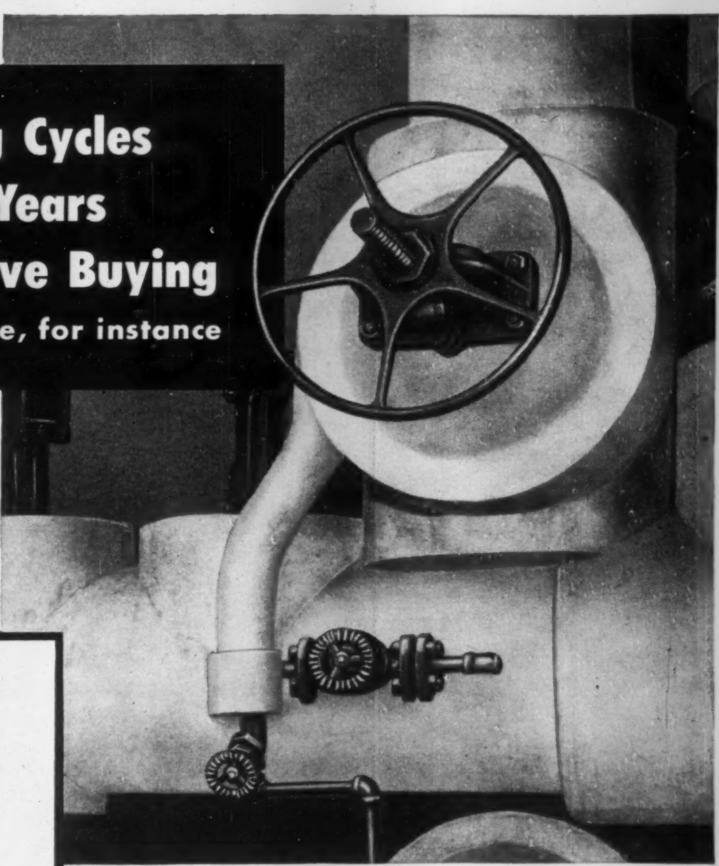
Dept. RDQ-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

1248 Operating Cycles Through 24 Years Prove Quality Valve Buying

. . . for main steam service, for instance



The Installation

At the Champion-International Paper Mill, Lawrence, Mass., featuring Crane 400-pound steel gate valve in main steam line to turbine. Working pressure: 400 psi at 600 deg. F.

Valve Service Ratings

SUITABILITY: Never a question

FEATURES: Quality throughout

MAINTENANCE COST: Not a cent

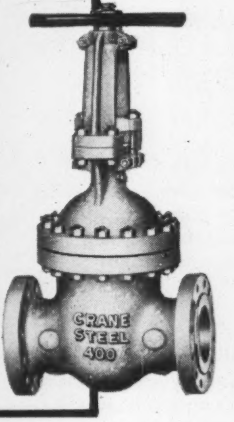
SERVICE LIFE: 24 yr.—still in line

OPERATING RESULT: Lower power costs

AVAILABILITY: Regular Crane Catalog item

The Valve

Improved constantly through the years, Crane steel valves for elevated pressures and temperatures are known and respected everywhere for outstanding, low-cost performance. They're made in the widest range of body and trim materials—in all pressure classes and sizes—with screwed, flanged, or welding ends. See your Crane Catalog, or consult your Crane Representative.



The Case History

Installed in 1930, this Crane valve has been in continuous use ever since. In 24 years the valve has not required service or maintenance of any kind.

More significant is the quality of performance of this 8-in. steel gate valve. Operated for week-end shutdown of the turbine, it has never failed to respond to the handwheel with smooth, steady action. Both seating and stem seal remain as tight as when the valve was first installed.

Performance like this begins in just one way—by making quality the first consideration when buying valves. Today, such a buying policy is sounder than ever and Crane quality, more than ever, helps assure the best results at lowest ultimate cost.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, IRON, STEEL

CRANE VALVES

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Branches and Wholesalers Serving All Industrial Areas

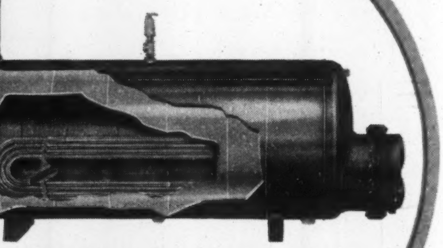
for
the
THRIFTY
BUYER

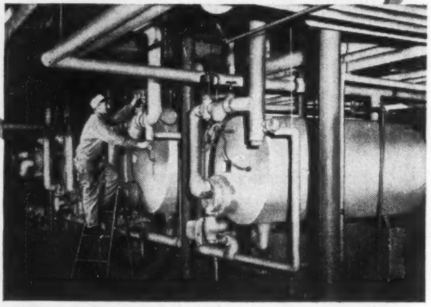
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

for Rust-Free Hot Water

look for the Copper Lining

they did at this
SEALTEST PLANT





Pure, rust-free hot water is a *must* for dairy operations. For that reason, the men responsible for specifying hot water heaters for Supplee-Wills-Jones Milk Company in Philadelphia decided many years ago on p·k copper-lined hot water storage heaters as the best bet against corrosiveness in water.

For this plant, five p·k hot water heaters have been used for processing, cleaning, sterilizing and for general utility purposes. Recent examination of these heaters discloses no sign of corrosion. Copper linings remain bright and unpitted. Maintenance? Just routine.

A p·k Copper-Lined storage heater combines the non-corrosive properties of copper with the outstanding strength of steel . . . a complete, copper heater built inside of and reinforced by a heavy steel shell.

For an unfailing source of pure, rust-free hot water,

LOOK FOR THE p·k Copper Lining

Comprehensive catalog gives you all the facts.
It's yours for the asking.

the **Patterson-Kelley Co.,** inc.
810 Burson Street, East Stroudsburg, Penn.

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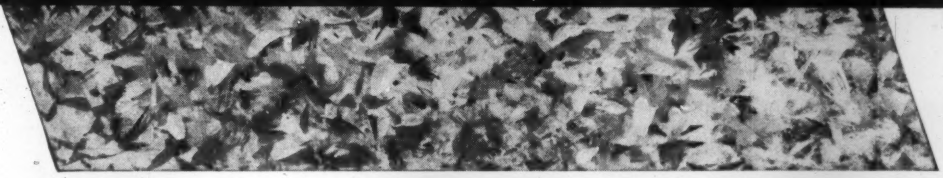
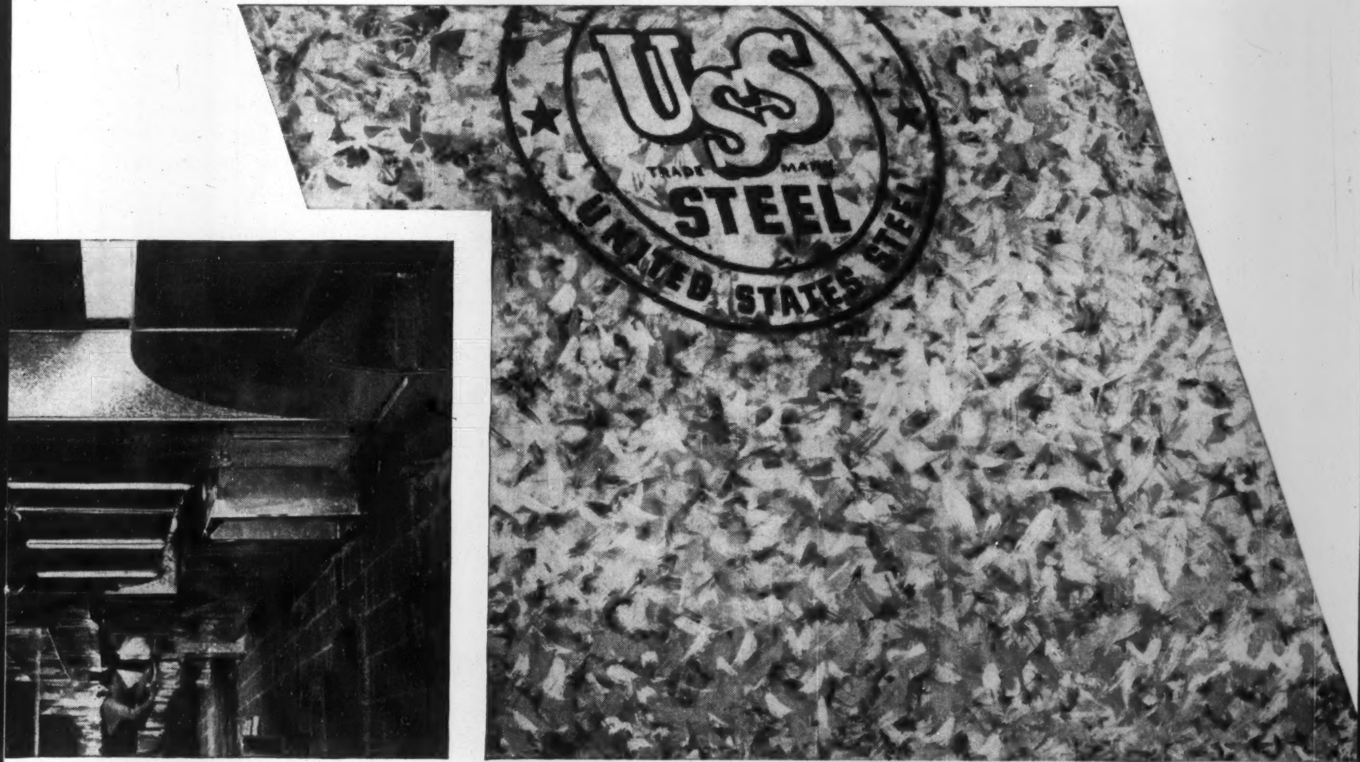
101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities.



USS Galvanized Steel Sheets

assure uniformity in quality throughout the job



WHEN you select USS Galvanized Steel Sheets to construct a large ductwork installation in a multistoried building, you can be sure of uniform quality from the first sheet to the last. USS Galvanized Steel Sheets are manufactured according to rigid specifications, and every shipment is carefully checked to make sure that it conforms.

USS Galvanized Steel Sheets fabricate easily, even under difficult working conditions. They are uniform in softness, flatness and surface . . . can be rolled, bent, cut, stamped or soldered. The heavy, corrosion-resisting zinc coating won't crack or flake during handling.

Your customers are familiar with USS Steel Sheets – and the USS Label. They know this label stands for dependable quality in steel of every kind. To assure continuing good jobs and customer approval, be sure to specify USS Galvanized Steel Sheets by name when you place an order.

For more information about USS Galvanized Steel Sheets, ask your sheet distributor or our nearest district office. United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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USS GALVANIZED STEEL SHEETS

4-1896

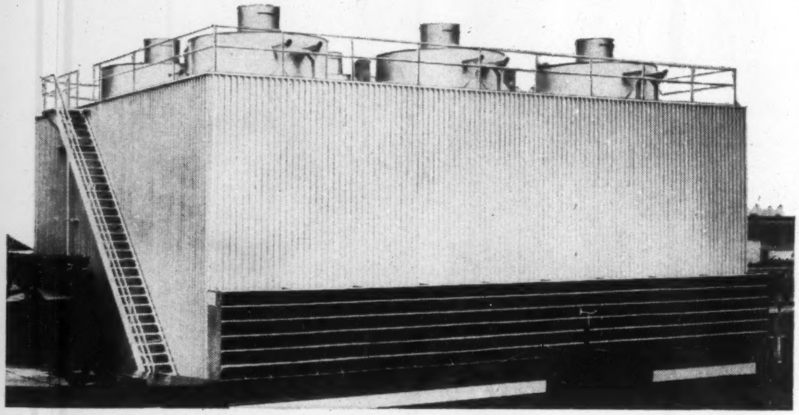
UNITED STATES STEEL

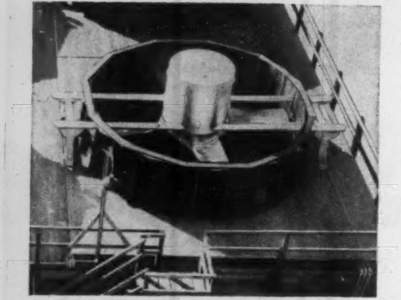
WHY ?

Why do hundreds of critical engineers and contractors choose Pritchard to help them solve their comfort cooling problems?

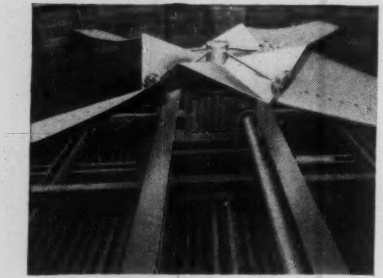
Right now, you probably don't have time to read all the reasons, so we've just pictured several of them for you. But, next time you want the right tower for a specific cooling job, contact Pritchard and find out the rest of the reasons why.

Your Pritchard representative is listed in the classified section of the telephone directory, or you can write direct to the address given below.

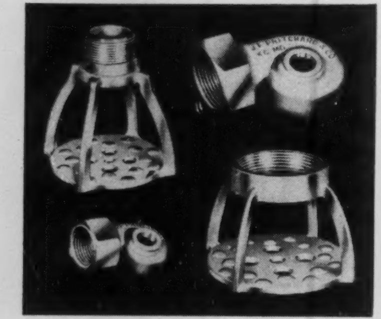




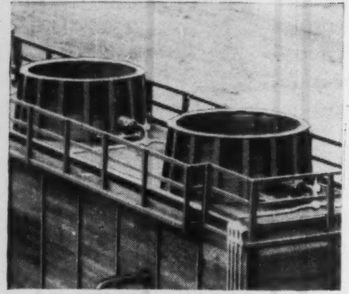
PATENTED FAN DRIVES
Self-ventilated, fully encased, completely integrated assembly.



EXCLUSIVE FANS
Designed especially for cooling tower service, low horsepower requirements. Right angle worm gear drive shown here.



MORE EFFICIENT DISTRIBUTORS
Patented low-pressure design for better spray, more efficient cooling.



SUPERIOR FAN THROATS
All redwood unitized design, modified Venturi throat permits close blade tolerances, assures highest efficiency.

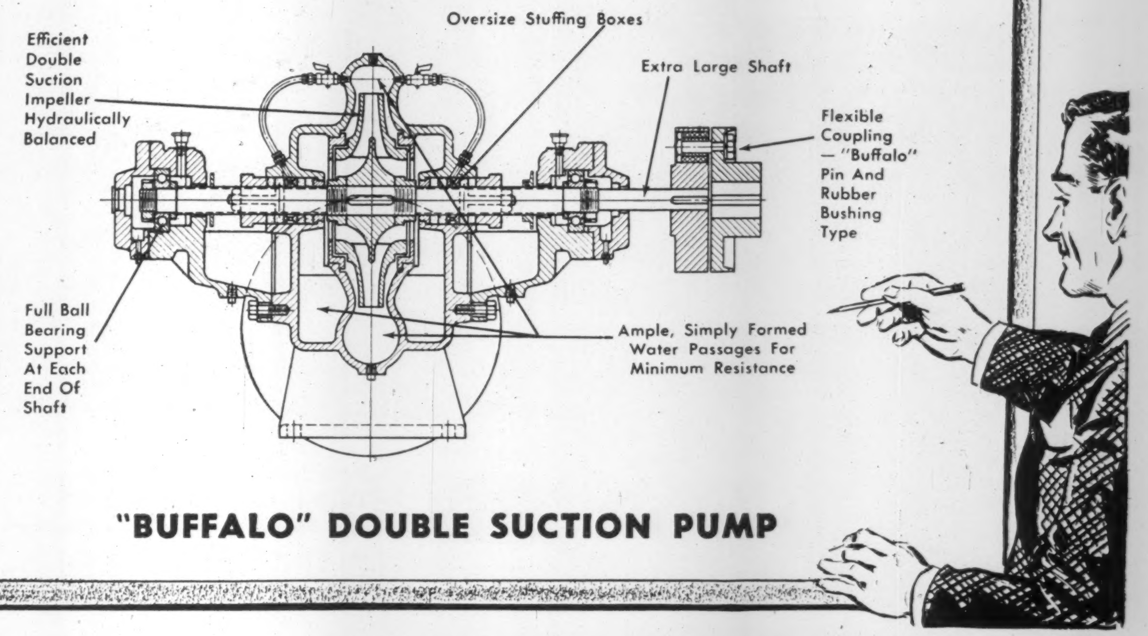
Industry's Partner for Progress

J. F. Pritchard Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 410, 210 West 10th St., Kansas City 5, Mo.

COOLING TOWERS
SPECIALIZED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

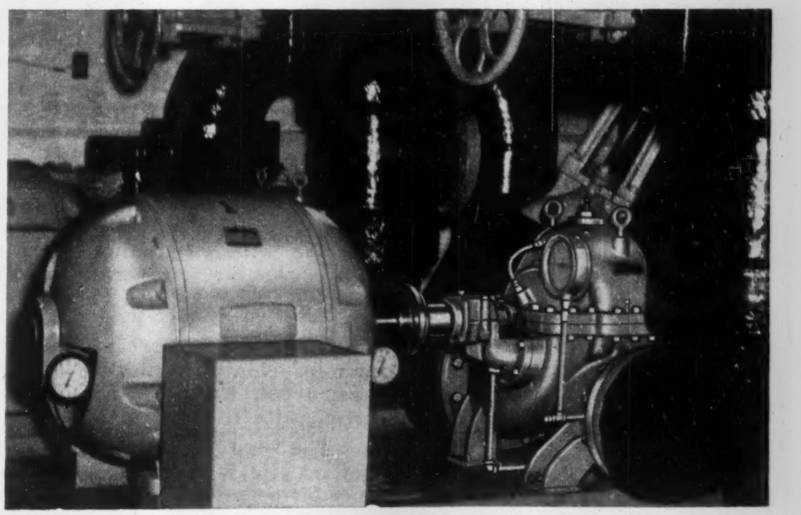
Representatives in Principal Cities from Coast to Coast.

Designed To Make Your Pumping Dollar Go Further!


Oversize Stuffing Boxes
Efficient Double Suction Impeller Hydraulically Balanced
Extra Large Shaft
Flexible Coupling — "Buffalo" Pin And Rubber Bushing Type
Full Ball Bearing Support At Each End Of Shaft
Ample, Simply Formed Water Passages For Minimum Resistance

"BUFFALO" DOUBLE SUCTION PUMP

Whether you need high-volume pumping of chilled water, water for air washing or any other clear water application, you'll find that the excellence of design in "Buffalo" Full Ball Bearing Double-Suction Pumps pays you in long life, quiet operation, high efficiency, reliability and freedom from frequent shutdowns for repairs. It goes without saying that this is the cheapest kind of pumping service. Bulletin 955-P describes these popular pumps in detail. Write for your copy today!



"Buffalo" Double Suction Pumps Handling Chilled Water in a Large Printing Plant.

"Buffalo" PUMPS

BUFFALO PUMPS, INC.

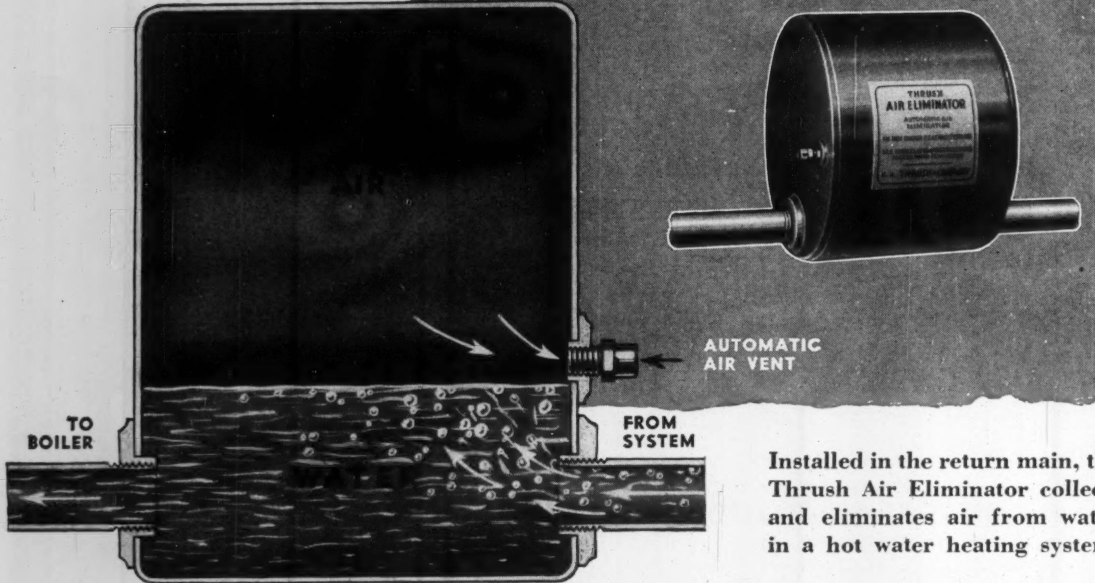
171 MORTIMER ST. BUFFALO, N.Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

END *Air Troubles* IN HOT WATER HEATING

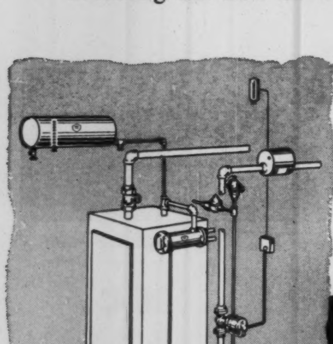


Installed in the return main, the Thrush Air Eliminator collects and eliminates air from water in a hot water heating system.

THRUSH AIR ELIMINATOR

removes air from hot water systems!

THE NEW THRUSH Air Eliminator provides a simple, inexpensive but highly efficient means of collecting and automatically removing air from radiant coils, baseboards or convectors. Air in water moves with circulation and is trapped and released in the Eliminator, thus preventing air from interfering with circulation. This operation is accomplished by breaking the flow of water, which causes air to separate from the water.



The Complete Thrush System

The Thrush Air Eliminator is easy to install in the return main as shown in the system diagram below. It is ruggedly constructed. Each Air Eliminator is shipped in an individual carton, with full instructions.

For real customer satisfaction, install complete Thrush Radiant Hot Water Heat as shown in the illustration at left. For more information see your wholesaler today or write Dept. E-11.

H. A. THRUSH & COMPANY
PERU, INDIANA

What's YOUR heating job?

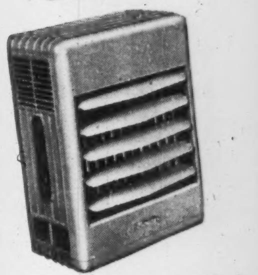
STEAM?

Modine builds 28 sizes of vertical delivery units—14 for standard and 14 for low outlet temperatures—with choice of four easily attached deflectors. There are also 19 horizontal and ten power throw models for standard and low outlet temperatures.

HOT WATER?

Vertical delivery units come in 14 sizes with a choice of 4 easily attached deflectors. Five horizontal models are designed specifically for hot water. Five power throw models are also available.

GAS?



Only Modine gas-fired unit heaters have stainless steel burners and a choice of stainless or aluminized steel heat exchangers. Seven sizes—25,000 to 220,000 Btu. A.G.A. and C.G.A. approved for natural, mixed, manufactured, LP and LP-air gases.

You name it—
Modine has the unit heater to do it better . . . at lower cost

WHATEVER your unit heating needs, you can depend on Modine for maximum heating comfort at lowest possible fuel cost. For over 25 years, the Modine name has been synonymous with quality and advanced engineering.

Take steam and hot water unit heaters, for example. Discharge air temperatures of 110-120° F are correctly related to air velocity for heating at its best. There's minimum heat loss compared to some units that discharge air at such high temperatures that it immediately rises to the ceiling, or others with velocities so low that the heat reaches only a small area.

As for gas-fired unit heaters, Modines are only half the weight, half the size of other leading makes. You save installation costs, save on shipping charges. And this same advanced design means longer life, five-second heating response to thermostat's demand.

Yes, from every angle . . . for every job—you're way ahead when you specify Modine unit heaters. You'll find it pays to buy the greatest name in unit heating.

Modine
UNIT HEATERS

For facts on steam and hot water unit heaters, see the Modine representative listed in your classified phone book. Or write today for your copy of Catalog 154.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

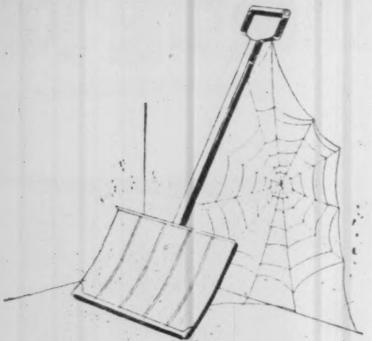
Modine
GAS FIRED
UNIT HEATERS

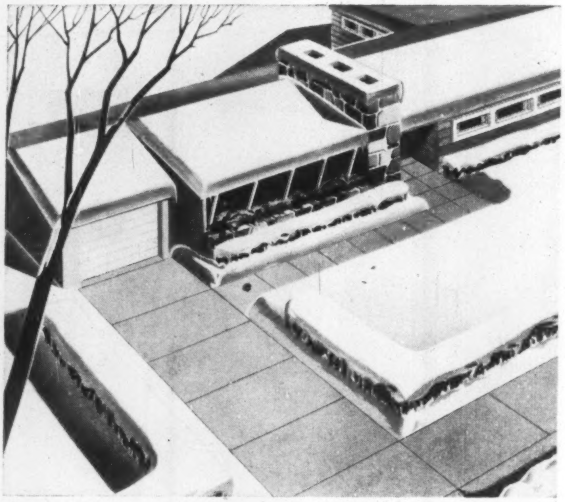
Get complete information on gas-fired unit heaters. Write for Bulletin 654 to Modine Manufacturing Company, 1509 DeKoven Avenue, Racine, Wisconsin.

U-1231

Modine UNIT HEATERS

The old snow shovel's gathering dust



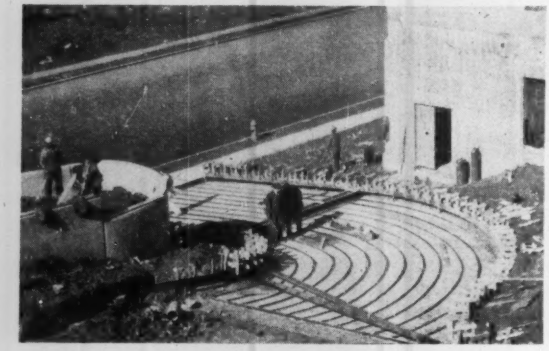


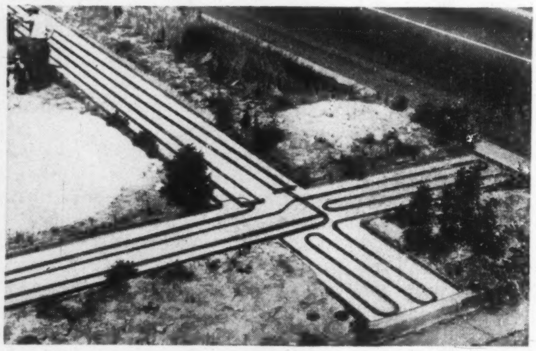
TODAY'S modern snow melting installations have sent many a snow shovel into retirement. In addition to being used for residential sidewalks and driveways, hundreds of snow melting systems have been installed at hotels, office buildings, church entrances, theaters, train platforms, and bus terminals throughout the snowfall areas of the United States.

Besides taking the aching back out of a tiresome winter chore, snow melting systems take the accident and lawsuit hazard out of dangerous, icy sidewalks. Moreover, when used in front of theaters, around department stores and other business establishments, they offer a wonderful psychological advantage. People tend to congregate in these clear areas on bad winter days. Thus, the snow-free sidewalks before a place of business create good will, and the merchandise on display there is seen by large groups of people.

For over 50 years, architects, engineers and contractors have been specifying NATIONAL Steel Pipe for conventional plumbing and heating systems until it has become the nation's standard for such applications. It is only natural, then, that they should turn to NATIONAL for this relatively new application—snow melting systems. They know that NATIONAL Pipe has the inherent characteristics necessary to meet the requirements of such applications – smooth, uniform bending; sound, strong welding properties; and long service life. Small wonder that such confidence has made NATIONAL Steel Pipe America's largest selling pipe for snow melting service.

WALLS WITHOUT
WELDS





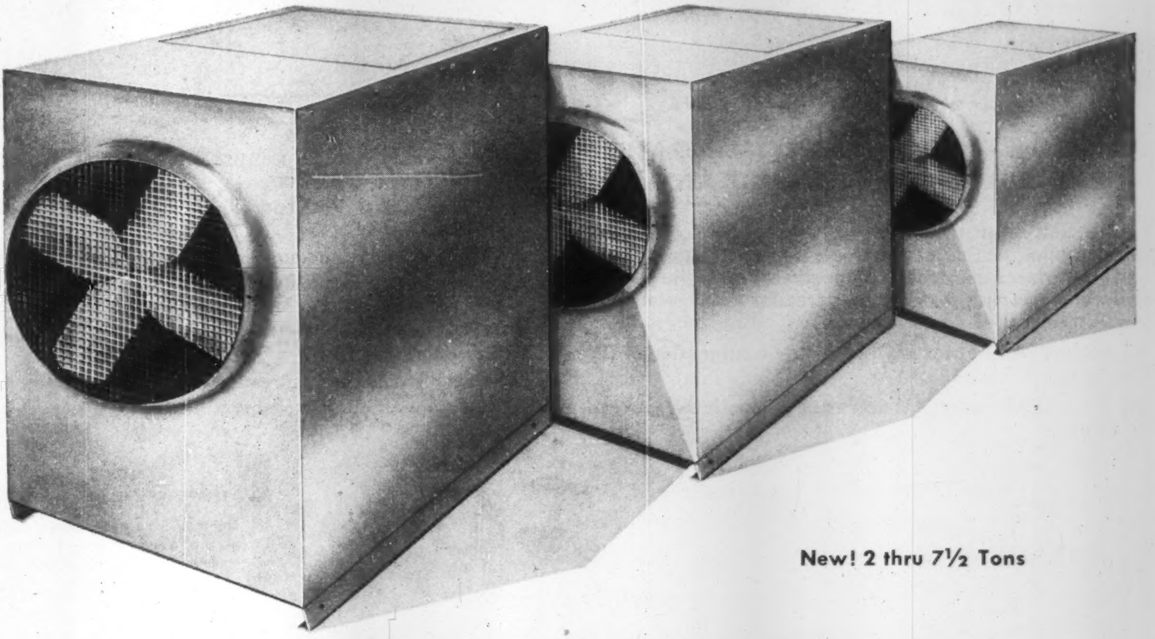
NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL *Steel* PIPE

UNITED STATES STEEL

RESIDENTIAL COOLING TOWERS



New! 2 thru 7½ Tons

ONLY HALSTEAD & MITCHELL OFFERS THE

20-Year Guarantee!

ON THE WETTED DECK SURFACE

PRICED FOR THE HOME MARKET

Price-wise these Halstead & Mitchell Residential Cooling Towers throw open huge segments of the home and small building market to air-conditioning. Here is the development for which the industry has been waiting. Check prices today!

NOW REQUIRED IN MANY AREAS

Residential Cooling Towers recirculate precious water . . . meet requirements of municipalities which prohibit wasting cooling water to sewers. And low cost H&M units take residential air conditioning to the suburbs and rural area . . . recirculate from a cistern if need be!

MADE FOR REAL OPERATING ECONOMY

Economical, lastworthy . . . low operating cost matches low initial cost. Efficient gravity-type distributing pan eliminates windage loss since atomizing by spray nozzle is unnecessary. Low pump head pressure is another bonus of gravity distribution. And maintenance is a snap!

FAMOUS HALSTEAD & MITCHELL QUALITY

Here's *all* the quality for which Halstead & Mitchell Cooling Towers are world famous — including the 20-year Guarantee on the wetted deck surface of pressure-treated creosoted wood, against attack by rotting or fungi growth. Stainless steel fans and shafts, plus individual cabinet coatings of Vinsynite, Vinyl Zinc and chlorinated rubber add important years of life. The complete assembly is with Everdur bolts . . . disassembly is easy even after years of service.

AT LEADING WHOLESALERS EVERYWHERE

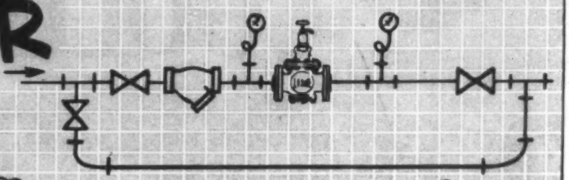
Write for descriptive bulletin from Halstead & Mitchell, one of the world's largest manufacturers of water-cooled Cleanable Condensers, and Cooling Towers up through 100-tons.

HM

Halstead & Mitchell

OFFICES: BESSEMER BUILDING • PITTSBURGH 22, PA.

WHEN TO USE A REGULATOR



SELF-CONTAINED PRESSURE, TEMPERATURE AND PUMP PRESSURE REGULATORS

Leslie Self-Contained Regulators are spring loaded, internal pilot, piston or diaphragm operated with stellited seating surfaces, hardened stainless steel main valves and renewable wearing parts of heat treated stainless steel of grades best suited to the application.

Regulators are used for any one or any combination of the following conditions:

★ When quick response is necessary to handle sudden load changes.

★ When available fluid pressure supplies sufficient differential for self operation.

★ When positive dead end shutoff is required for short periods of time.

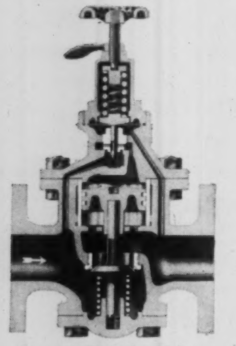
★ When one-step pressure reductions are desired.

★ When service conditions require continuous flow for varying demand.

★ When "instrument control" is required without auxiliary operating force.

★ When installation requires smallest physical dimensions.

★ When operation from either a nearby or a remote control station is desired.

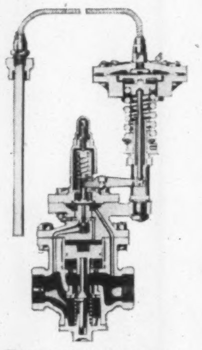


Pressure Reducing Valve
Class L-3

LESLIE
PRESSURE REDUCING VALVES

Automatically maintain a constant reduced pressure of steam, air or gas. Single seated, tight closing. Respond instantly to load changes. Renewable, interchangeable parts. Stellited seating surfaces. Complete overhaul permitted without removing body from pipe line. Made in bronze, cast iron, cast steel or cast alloy steels. Sizes ½" to 6". Other units available for constant differential pressure, unloading, and for remote adjustment. Inlet pressures 25 psi to 1500 psi steam at 950°F. Reduced pressures 2-600 psi.

SEND FOR BULLETIN 5302



Temperature Regulator
Class LTCO

LESLIE
TEMPERATURE REGULATORS

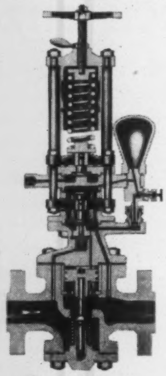
Designed for a wide range of applications. Vary the flow of steam or cooling water to heater or process to automatically maintain constant temperature. Rugged 100° F. adjustable range thermostatic element. For small and large flows, direct operated, direct and reverse acting or with "Duomatic", two-element (pressure and temperature) control. For driers, fuel oil heaters, instantaneous and storage heaters, kettles, open tanks, ovens, process heaters, degreasing machines, steam tables, sterilizers, storage heaters, urns, etc.

SEND FOR BULLETIN 5307

LESLIE
PUMP PRESSURE REGULATORS

Accurately and automatically control discharge pressure from steam operated, reciprocating or turbine driven pumps. Single seated—positive—responsive and accessible. No packed plungers or stuffing boxes. Built for constant discharge pressures of 8 psi to 2000 psi and excess pressure of 10-200 psi. For motor-driven pump discharge pressure recirculation.

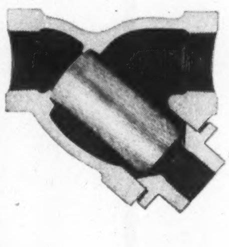
SEND FOR BULLETIN 5306



Pump Governor
Class CTHS-3

LESLIE
SELF-CLEANING STRAINERS

Recommended to protect all regulating equipment from dirt and foreign matter. Cast iron, bronze, cast steel, carbon moly, chrome-moly, stainless and forged steels. Strainers with screwed, flanged, socket and butt welded connections; sizes ⅛" to 10" inclusive. Primary service ratings to 2500 psi. Screens furnished in Monel and stainless steel with various perforations and meshes for liquid, gas, air, oil and steam services. For complete details on each type, ask for Bulletin 5308.



Self-Cleaning Strainer

3168

LESLIE REGULATORS

SINCE 1900

LESLIE CO., 237 GRANT AVENUE · LYNDHURST, N. J.

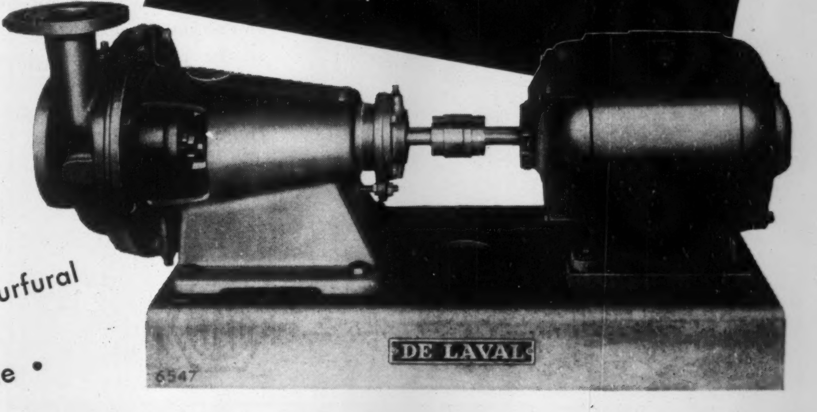
"STILL FAR AHEAD IN QUALITY AND PERFORMANCE"

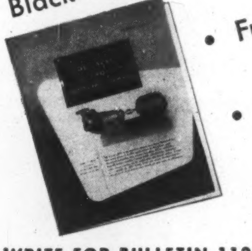
• Calcium chloride brine • Flushing liquor
Sodium sulphate • Asbestos fiber & cement mix • Green liquor •
Soap solution • Grinder coolant • Carbon slurry • Cane wash • Salt brine • Sea water •
• Caustic solution • Bleach liquor • Grape juice concentrate • Tomato juice concentrate •
Tomato puree • Propanol • Soap liquor • Cane juice • Aqueous lime • Coke oven oil •
• Paper stock • Waste sulphite liquor • Alkylaryl sulfonate • Sugar liquor • Vinyl pyridine
• Saturated brine • Grape juice • Tomato juice • Press liquor • Calcium bisulphite • Melt
Phenolized ammonia • Ammonia liquor • Sulphuric acid • Paraffine oil and water • Sludge
• Milk waste • Gritty water • Cane syrup • Lime & soda solution • Cachaza • Clear juice
White water • Mineral oil • Chromic acid
Cement • Gasoline • Depanol
Flume water •
Brine • Vegetable oil • Licorice liquor •
• River water • Benzine thinner • Mash
Methylene chloride • Sodium hydroxide
Sizing solution • Alcohol •
• Steep soda • Caustic soda
Black liquor • Ethylene glycol
• Fuel oil • Furfural
• Condensate •

One pump handles *all* these liquids...

DE LAVAL CPO PROCESS PUMP

CAPACITIES TO 2,000 GPM
HEADS TO 200 FT.



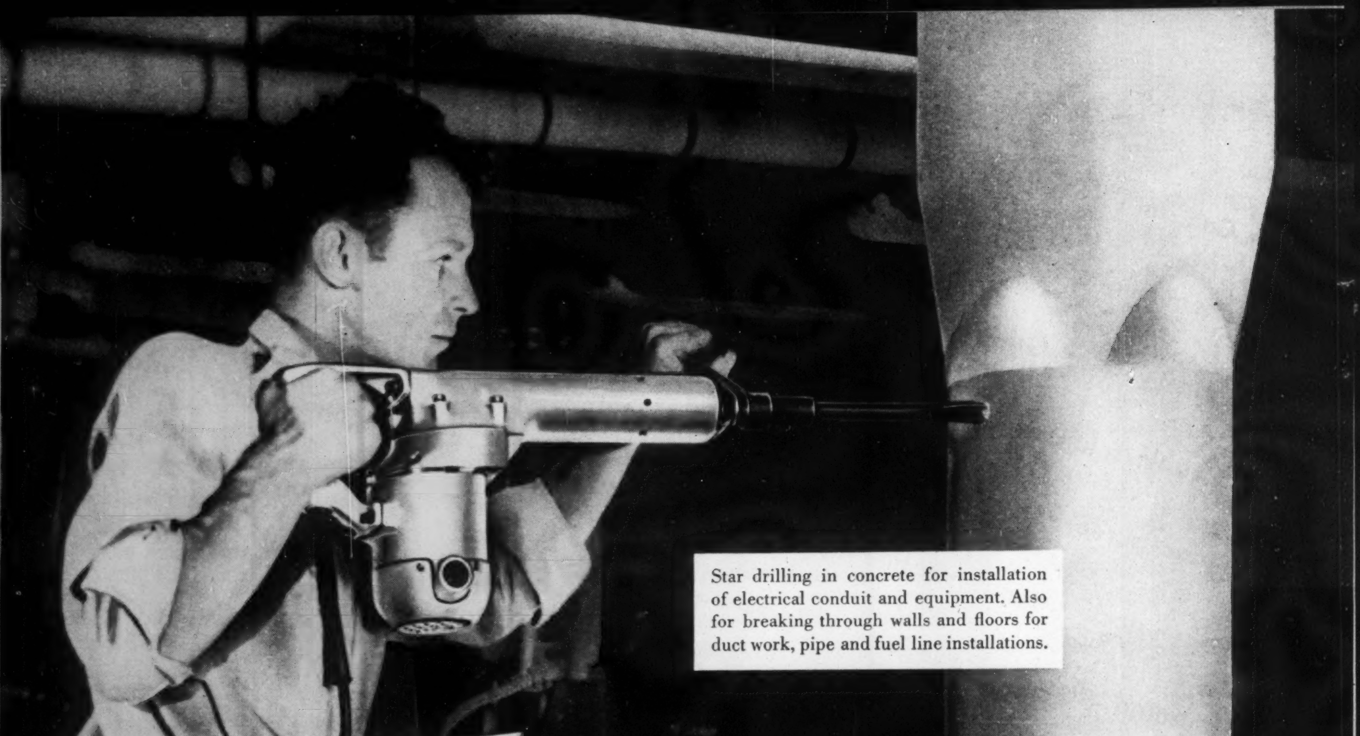


WRITE FOR BULLETIN 1125-B

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
871 Nottingham Way, Trenton 2, New Jersey

DL 281



Star drilling in concrete for installation of electrical conduit and equipment. Also for breaking through walls and floors for duct work, pipe and fuel line installations.

Black & Decker

ELECTRIC HAMMERS GIVE

MORE POWER TO YOU

to save time ... cut costs!

To DRILL DIG PIERCE BREAK

To CHISEL GOUGE CHANNEL NOTCH

To CHIP PEEL POINT CAULK

To BATTER SHAKE SHATTER SMASH

To do HUNDREDS of JOBS in INDUSTRY FASTER, BETTER, CHEAPER!

B&D A BLACK & DECKER HOW-TO-DO-IT BOOK

See where B&D Hammers save you time and money!

New Book shows how!

From drilling in concrete to holing-through walls, B&D Electric Hammers get more jobs done faster, better, cheaper! No other Hammer has so many features for comfort and safety. No other Hammer gives you so much working power in so little weight at such a low price! Get all the facts! Get this great B&D Hammer Handbook *FREE!* Page after page of on-the-job photos show how you can save time, cut costs on dozens of jobs in your own operation! Write to: THE BLACK & DECKER MFG. CO., Dept. 2811, Towson 4, Maryland. Meanwhile, ask your B&D distributor for a demonstration!

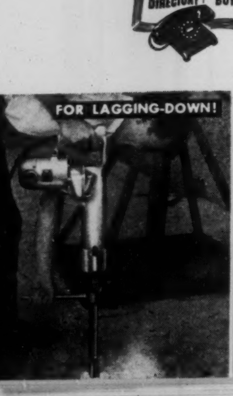
CLASSIFIED TELEPHONE DIRECTORY | TELLS WHERE TO BUY IT

For nearest distributor, see "Tools-Electric."

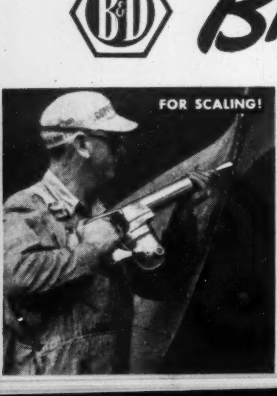
LEADING DISTRIBUTORS EVERYWHERE SELL

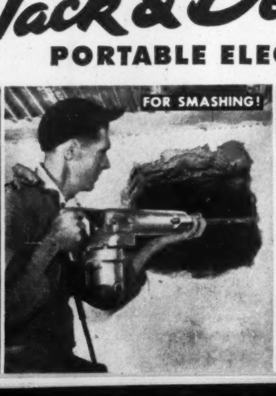
B&D Black & Decker

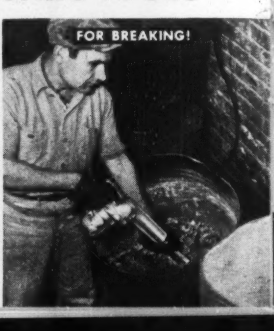
PORTABLE ELECTRIC TOOLS


FOR LAGGING-DOWN!

FOR CHANNELING!


FOR SCALING!


FOR SMASHING!


FOR BREAKING!

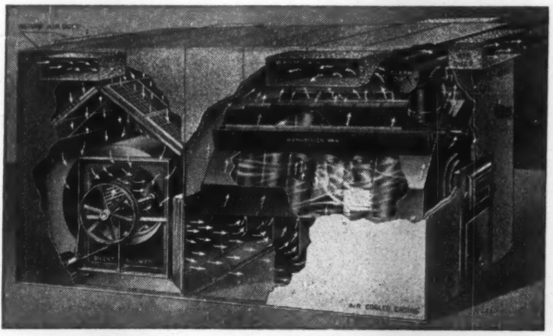
WARM AIR HEATED...

by Campbell

Highland Park Evangelical Free Church, Des Moines, Iowa. George A. Spooner, Architect, Des Moines. Comfortably heated since 1949 with a Campbell gas-fired 8000 series heater.

IDEAL FOR CHURCH INSTALLATIONS

Campbell 8000 Series Heaters offer three big advantages for church heating. They provide the fast heat delivery that is only possible with an efficient warm air unit. They supply abundant heat with remarkable fuel economy. They provide positive control of humidity and temperature, and are easily adaptable for summer air conditioning. Designed for easy installation. Available for all fuels in capacities up to 3,000,000 BTUs. Your inquiry will receive our prompt attention.



MANUFACTURERS' AGENTS

We have a number of attractive openings for manufacturers' agents who call on heating contractors and architects. If interested, please state territory you cover.

CAMPBELL HEATING CO.
Des Moines 17, Iowa

I am interested in your proposition for manufacturers' agents.

My territory covers..

NAME..

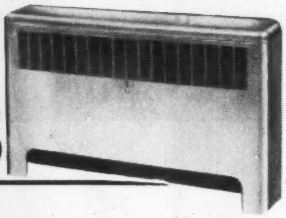
ADDRESS...

CITY..........................ZONE......STATE......

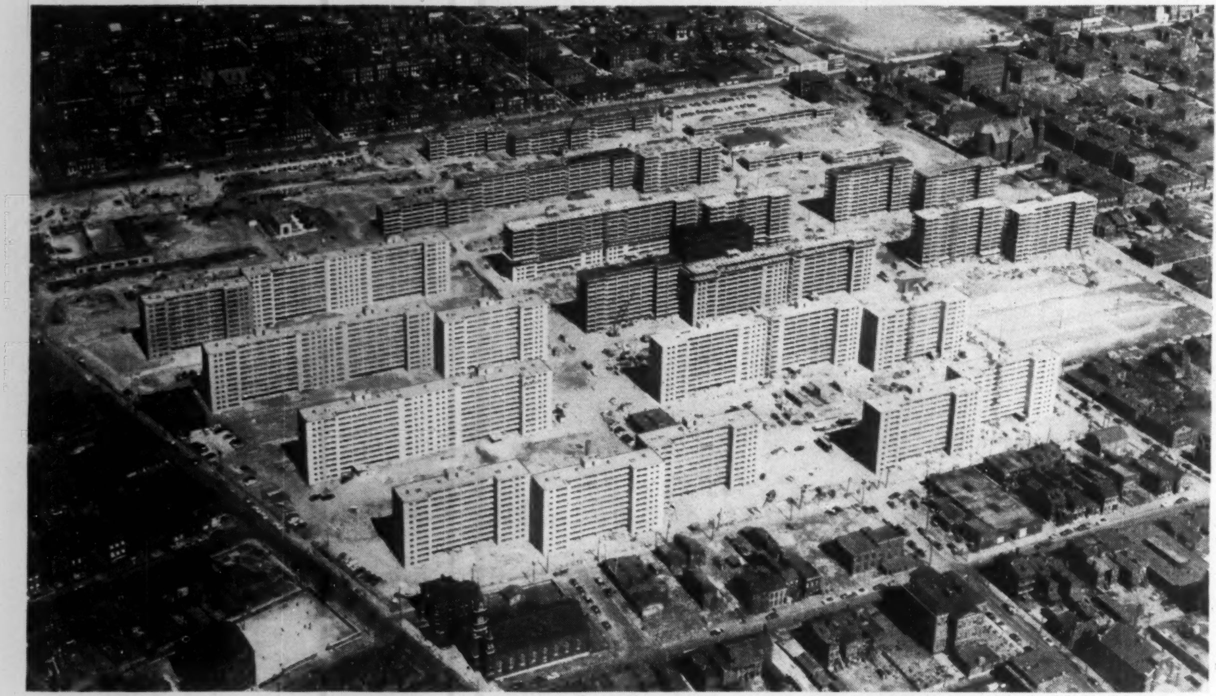
CAMPBELL HEATING COMPANY

Des Moines 17, Iowa

6600 *Airtherm* CONVECTORS



Add **Beauty and Comfort** to the . . .



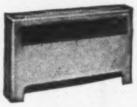
. . . 1736-Unit PRUITT Housing Project

The clean, uncluttered design of Airtherm Convectors blends perfectly with the modern decor of the new Wendell Oliver Pruitt Homes in St. Louis. Their outstanding performance, ease of installation and easy maintenance make them exceptionally practical for this huge housing project.

Airtherm Convectors, available in wall, recessed or free-standing models, can help you solve a wide range of heating problems. Write for Catalog 702-A or consult our Catalog in Sweets Architectural File 28c Ai.

See our catalog in
S
or write for copy

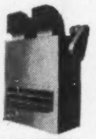
Architect—Hellmuth, Yamasaki & Leinweber, Inc.
Mechanical Engineer—John D. Falvey
General Contractor—Millstone Construction, Inc.
Heating Contractor—Kremer-Hicks Company



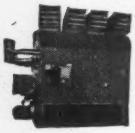
Convectors

Vertical Steam Unit Heaters

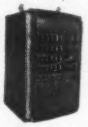
Horizontal Steam Unit Heaters



Centrifugal Fan Type Unit Heaters



Direct Fired Space Heaters



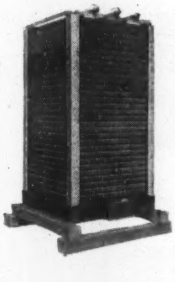
Gas Fired Unit Heaters

FOR HEATING SATISFACTION . . . THINK FIRST OF

Airtherm

MANUFACTURING COMPANY
711 South Spring Avenue • St. Louis 10, Missouri

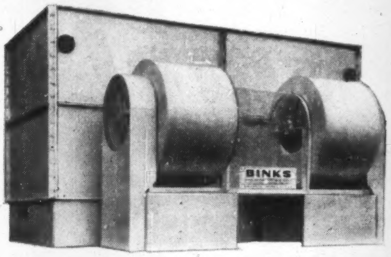
"PACKAGED" COOLING TOWERS—THE ANSWER TO LOW-COST OPERATION



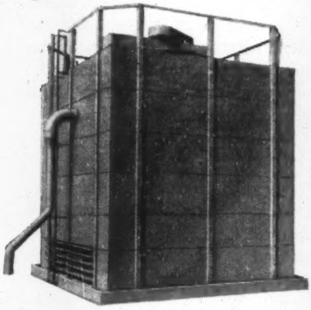
The growing use of cooling towers as a part of all air conditioning systems has made it possible to produce towers by mass production methods. These "packaged" units are superior in many ways to the former custom-made towers because they are better designed and thoroughly factory-tested under varying conditions.

Above: **Binks Type "H" Series—widely used for refrigeration and air conditioning. Capacities range from 4 to 40 tons.**

Below: **Binks 3BB Series Multiple Blower Cooling Towers—Capacities range from 40 to 125 tons.**

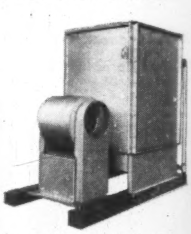


Packaged towers come in both natural and mechanical draft models...ranging from small, extra quiet towers for indoor use in residential air conditioning systems to larger towers capable of serving an entire building.



Above: **Binks 2-K Series Induced Draft Cooling Towers. Capacities up to 800 tons.**

Below: **Binks 3-B Series Single Blower Cooling Towers. Capacities range from 5 to 36 tons.**



One of the most complete lines on the market today is offered by the Binks Manufacturing Company, pioneers in this field. Binks engineers will help you select the right tower for any particular installation, upon receipt of information regarding local conditions, tonnage requirements, and cooling range required. 3118-38 Carroll Avenue, Chicago 12, Illinois.

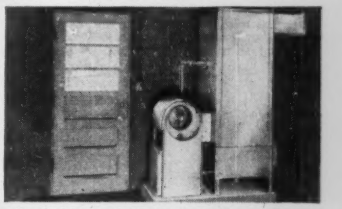
New Residence Cooling Tower Cuts Air-Conditioning Costs

Saves 95% on cooling tower bills... today a cooling tower is a must in every air conditioning installation involving water cooled condensing units. Homes are no exception. In many communities the use of water for this purpose is restricted. In others high water rates result in excessive operating costs. A Binks Residence Cooling Tower makes it possible to cool and recirculate the condensing water...at a tremendous saving.

HERE'S WHY you will prefer Binks residential towers:

1. **Quiet operation!** Noiseless, squirrel-cage type blower supplies ample air movement at operating speeds far below the noisy propeller-type fans used in conventional cooling towers. All metal-to-metal connections are rubber cushioned. Interior surfaces are protected and soundproofed with heavy undercoating.
2. **Compact!** Fits into small space...in basement, garage, breezeway, out-doors.
3. **Easy to install!** Comes fully assembled ready for immediate water, electric and duct connections.
4. **Low maintenance!** All metal surfaces are heavily galvanized and given several coats of good paint. Construction is rigid. Nozzles are clog-proof. No moist air reaches the air propulsion mechanism.
5. **Efficient!** Binks' 25 years experience in the development and manufacture of successful commercial towers assures correct design and high efficiency for this residence tower.
6. **Attractively priced!** These towers are mass produced for economy.

Because of their noiseless operation, Binks cooling towers can be placed in utility or recreation rooms.



Available space in garage, carport or breezeway can be used.

Send today

for free Bulletins 47-B and 47-D which describe Binks Residence Cooling Towers in refrigeration capacities of 2 and 3 tons.

MAIL COUPON NOW

Binks

EVERYTHING FOR WATER COOLING

Binks Manufacturing Company
3118-38 Carroll Avenue, Chicago 12, Illinois

Gentlemen: Please rush FREE Cooling Tower Bulletins 47-D and 47-B } and other facts including prices.

Name____________________

Company____________________

Address____________________

City__________ Zone_____ State______

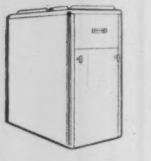
why worry?

INSTALL

Petro

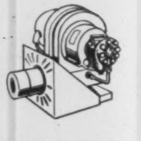
HEATING OR
POWER EQUIPMENT

and be sure!



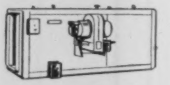
OIL AND GAS FURNACES AND BOILERS

Complete winter air conditioners built in popular sizes to fit the heating needs of homes from 4 to 10 rooms. Real fuel-savers.



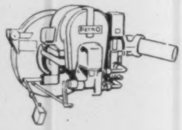
OIL CONVERSION BURNERS

Oil burners for residential use. Commercial and industrial oil, gas, and combination oil-gas burners. Residential oil burner illustrated.



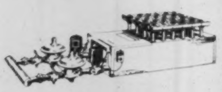
HORIZONTAL OIL FURNACE

Hang it or hide it—this winter air conditioner fits anywhere. Available in 5 models from 80,000 to 180,000 Btu's (output at bonnet).



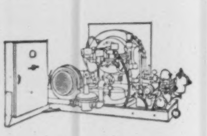
INDUSTRIAL OIL BURNERS AND OIL-GAS COMBINATION BURNERS

Rotary type. Burn low-cost, heavy fuel oil with complete reliability. Models for every industrial need. Capacities up to 200 gallons per hour. Combination oil-gas models are available.



INDUSTRIAL GAS BURNERS

Vertical type, readily adaptable to any conventional boiler. Zone fire enables low-fire start and modulated firing. Capacities 6 to 500 boiler hp.



COMPLETE "PACKAGED UNITS" FOR OIL, GAS OR BOTH

A complete combustion system in which all elements are completely balanced and integrated. Control panel factory wired and tested. Saves installation time and cost—gives top performance.

Petro equipment has a well earned 51-year reputation for dependable, economical service

COMPLETE LINE

With Petro equipment you *know* that you can get the exact size and model that you need—for any residential, commercial, or industrial installation.

SIMPLE, DEPENDABLE OPERATION

Petro oil and gas burners cost the boiler plant operator or home owner less to own and operate because their performance is proved and simple. The fine reputation Petro equipment enjoys, and its popularity with owners, is the result of this simplicity and traditional dependability.

EASILY INSTALLED

Petro oil and gas burners are compact and well built. Heavy mounting flanges, protected wire connections, easy access to fuel and ignition lines, are all features which help make Petro oil and gas burners the favorite of contractors and dealers everywhere. These features save installation time and cut service calls.

LOW FUEL COST

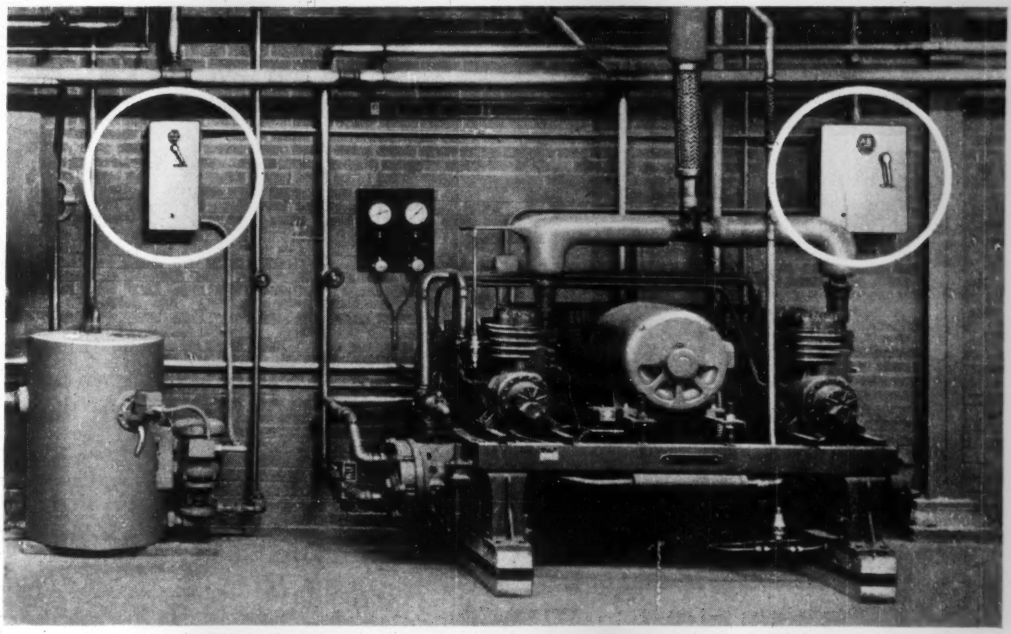
Stingy with fuel and generous with comfort—that's the story of Petro equipment. The result is satisfied customers who recommend you and Petro equipment to their friends. Write for complete information and specification sheets, 3046 West 106th St., Cleveland 11, Ohio. In Canada: 2231 Bloor Street West, Toronto, Ontario.

Residential Oil and Gas Burners, Oil and Gas Furnaces and Boilers, Industrial and Commercial Oil, Gas and Oil-Gas Combination Burners

PETRO

T. M. REG. U. S. PAT. OFF.

OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT



Frigidaire compressor unit operated by Allen-Bradley control.

FRIGIDAIRE COMPRESSORS operated by

ALLEN-BRADLEY

TROUBLE FREE MOTOR CONTROLS

Why are Allen-Bradley automatic starters so popular for refrigeration and air-conditioning service? . . . Because they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

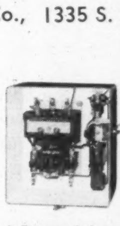
No contact maintenance . . . Allen-Bradley cadmium silver alloy contacts never need cleaning, filing, or dressing.

Dependable overload relays . . . Allen-Bradley thermal relays are accurate and always dependable . . . even after long service.

The Allen-Bradley trademark stands for millions of trouble free operations. Specify Allen-Bradley control, today.

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.

Say "Allen-Bradley" when ordering relays or motor controls. Your "Engineered" Special Refrigeration Controls ought to be discussed with Allen-Bradley.



A-B special refrigeration control unit.

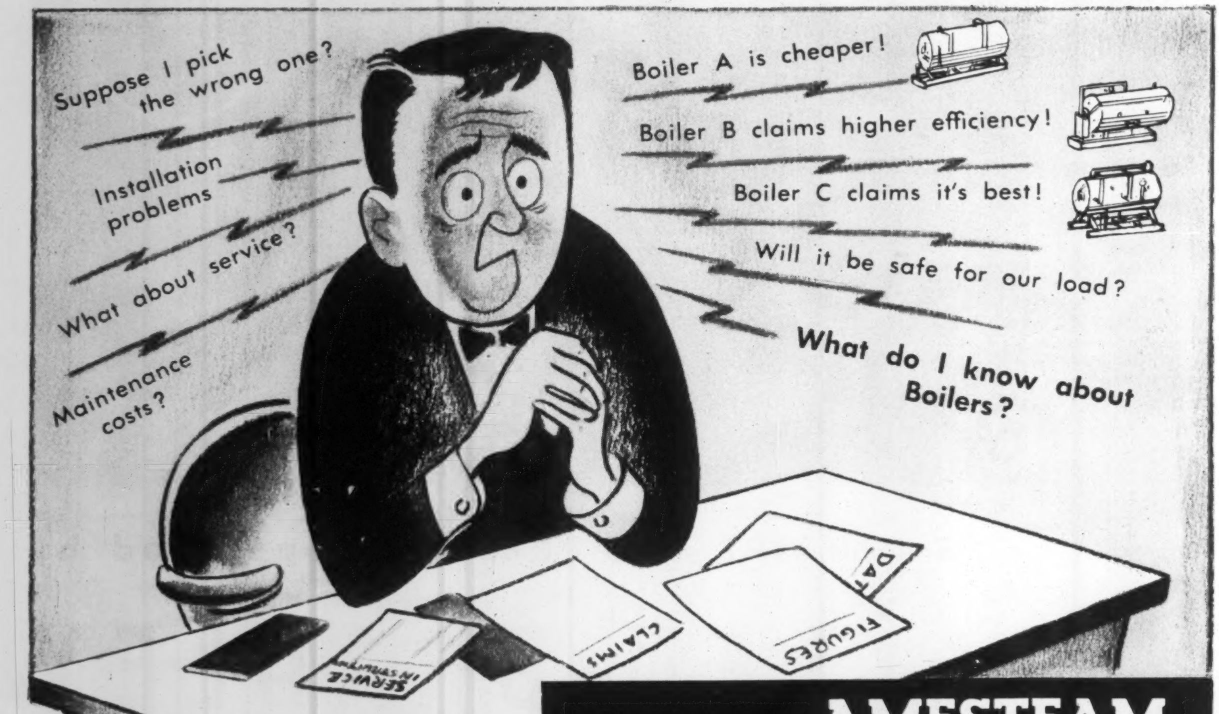
WRITE for this Allen-Bradley Air Conditioning and Refrigeration Bulletin.

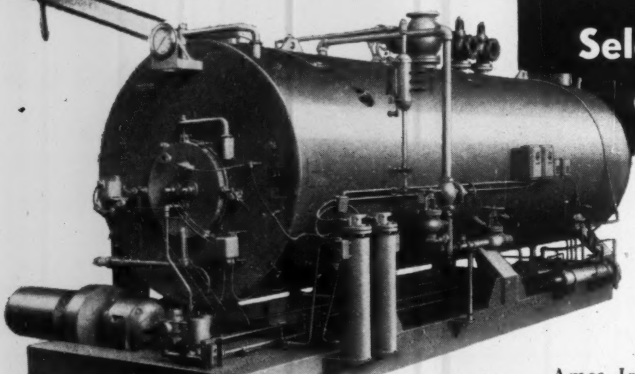
A-B
Quality

ALLEN-BRADLEY SOLENOID MOTOR CONTROLS

QUALITY MOTOR CONTROLS FOR HEATING, VENTILATING, AIR CONDITIONING, & REFRIGERATION INDUSTRIES

SO YOU HAVE TO BUY A BOILER!


Suppose I pick the wrong one?
Installation problems
What about service?
Maintenance costs?
Boiler A is cheaper!
Boiler B claims higher efficiency!
Boiler C claims it's best!
Will it be safe for our load?
What do I know about Boilers?
SERVICE INSTRUCTIONS
CLAIMS
FIGURES
DAT



Select an AMESTEAM GENERATOR and solve all your problems

You don't have to dig through mountains of data to pick the boiler that will give your company the most economical and satisfactory service! It's more a question of *where* you buy it than what boiler you choose. What's the maker's reputation?

Ames Iron Works have been building boilers of quality for over 100 years. Back of every Amesteam Generator is this long, successful experience — represented by the Ames Engineering Staff, a large group of skilled boiler makers and an efficient, nation-wide sales and service organization at your disposal. Yes, quality and experience *do* count — and the thousands of Amesteam Generators giving dependable, low-cost service in power, process and heating applications are proof of it. Why not be *sure* by specifying Amesteam Generator? Write today for details and name of your Ames representative.

AMESTEAM GENERATOR

- **80% guaranteed thermal efficiency.**
- **Single economical package purchase.**
- **Package installation economy.**
- **Completely safeguarded.**
- **Easy, inexpensive maintenance.**
- **20 sizes, 10 to 600 H.P., 15 to 200# W.P., oil, gas or oil-gas combinations with quick fuel switchover feature.**

AMES IRON WORKS, INC.
BOX D-114, OSWEGO, N. Y.

New TEMTRIM Finned Pipe Radiation by American-Standard for Public, Industrial and Commercial Buildings

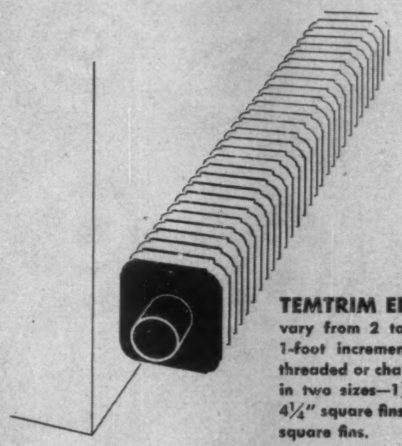
- ***Low cost***
- ***High heat output***
- ***Easy installation***
- ***Compact size***

● TEMTRIM is a welded steel pipe that bristles with steel radiating fins. It has a big, high-output heating surface, yet it is compact. Mounted on the wall, Temtrim projects only between 3 to 5 inches into the room.

TEMTRIM is economical to buy and install. Lengths of Temtrim can be connected and hung on wall brackets in a matter of minutes. Can be used with either hot water or steam systems for any type installation.

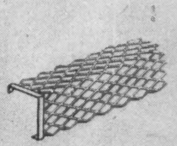
TEMTRIM can be installed with fins exposed, or with one of three attractive covers: expanded metal, louvered flat top or sloping louvered top. These sturdy steel covers are bonderized and finished with a gray prime coat.

With the addition of Temtrim, American-Standard offers a complete line of radiation for commercial and residential application. Included in the line are ferrous and non-ferrous baseboard panels and convectors and cast iron radiators, as well as remote type heating-cooling units. For information about Temtrim, mail coupon to **American Radiator & Standard Sanitary Corp.,** Dept. HP-114, Pittsburgh 30, Pa.

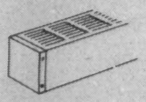


TEMTRIM ELEMENT LENGTHS vary from 2 to 12 feet in convenient 1-foot increments. Pipe ends can be threaded or chamfered. TEMTRIM comes in two sizes—1¼" I.P.S. with 3¼" or 4¼" square fins and 2" I.P.S. with 4¼" square fins.

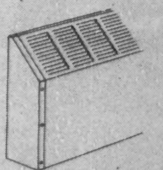
TEMTRIM COVERS are handsome and easily attached.



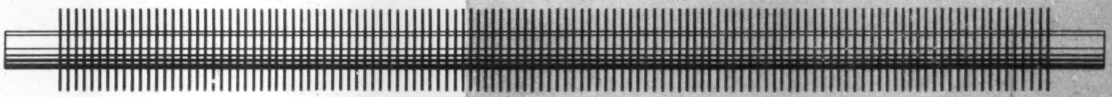
Expanded Metal



Louvered Flat Top



Sloping Louvered Top



TEMTRIM FINS are mechanically bonded to the pipe. They won't work loose.

American-Standard
HOT WATER HEATING

American-Standard
Dept. HP-114, Pittsburgh 30, Pa.

Please send me literature on TEMTRIM.

Name ....

Address ....

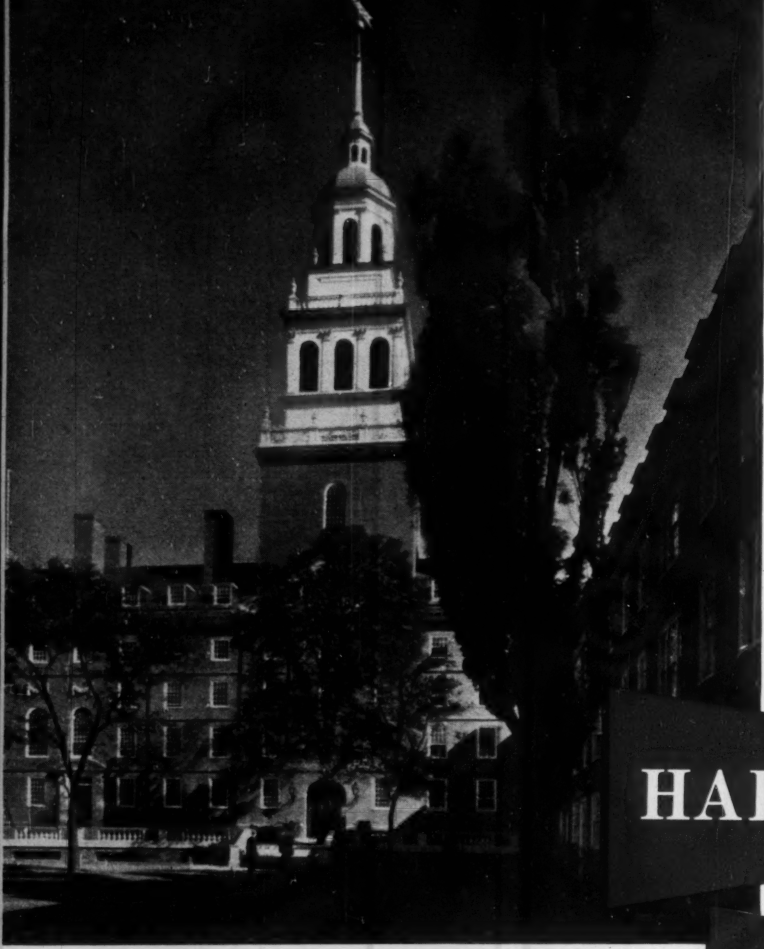
City .... State ....

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Architects: for Lowell House, Dunster House, McKinlock Hall, Vanderbilt Hall, Littauer Building, Gordon McKay Laboratory–SHEPLEY, BULFINCH, RICHARDSON & ABBOTT • for Aldrich Hall–PERRY, SHAW, HEPBURN, KEHOE & DEAN and McKIM, MEAD & WHITE, Associate Architects.

Mechanical Engineers: for Lowell House, McKinlock Hall, Vanderbilt Hall–FRENCH & HUBBARD • for Dunster House, Littauer Building–RICHARDSON & GAY • for Aldrich Hall–HAYDEN, HARDING & BUCHANAN • for Gordon McKay Laboratory–R. G. VANDERWEIL.

Heating Contractors: for Lowell House, McKinlock Hall–CLEGHORN CO. • for Dunster House–T. J. MURPHY & CO. • for Vanderbilt Hall–JAS. S. CASSEDY, INC. • for Littauer Building–V. J. KENNEALLY CO. • for Aldrich Hall–THE MERRILL CO., INC. • for Gordon McKay Laboratory–McLEAN-COUSENS & BARTON, INC.

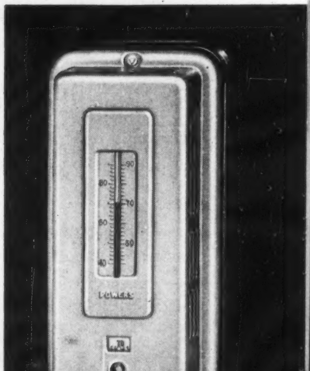


Above: Lowell House

Oldest university in the U.S.A.

HARVARD

...another distinguished user of



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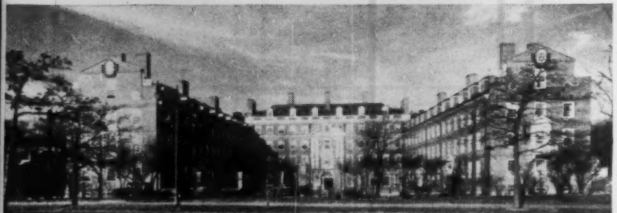

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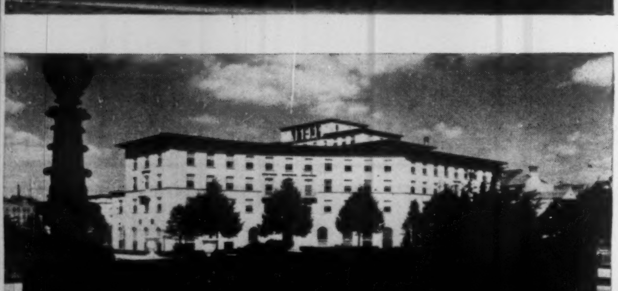
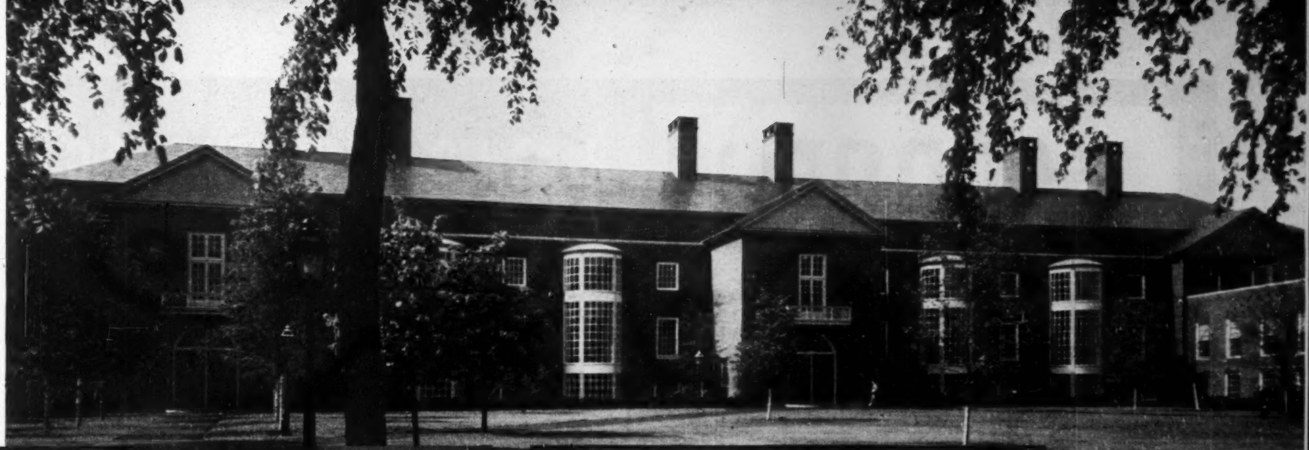
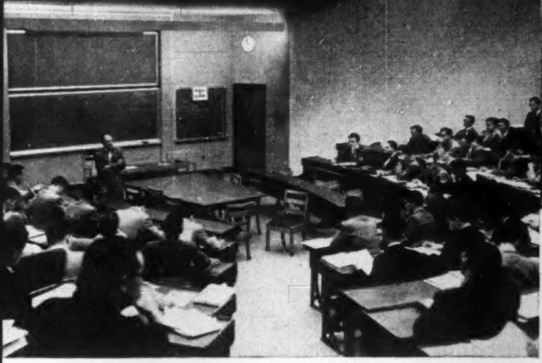


3

4

1 Dunster House, on the Charles River
2 McKinlock Hall
3 Vanderbilt Hall
4 Littauer Building



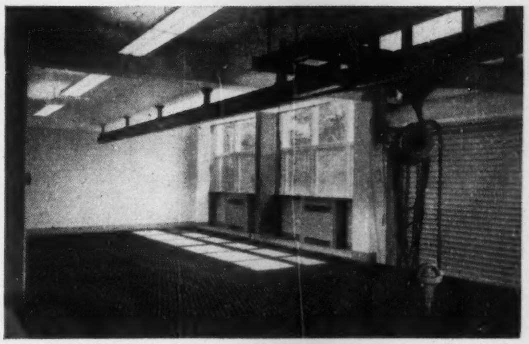


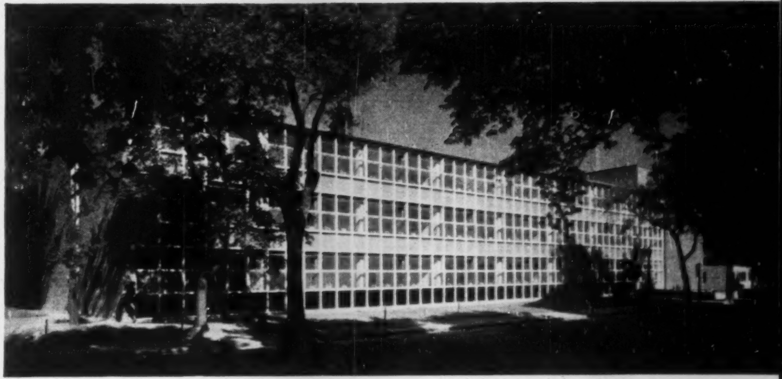
ALDRICH HALL Harvard Graduate School of Business Administration

One of the 17 unique classrooms shown at left seats 158 students; three others seat 80; and 13 accommodate 102 each. The rooms have been arranged to provide an intimate relationship between instructor and student in the give-and-take discussions by the case method generally used throughout the Harvard School of Business Administration.

Below: GORDON McKAY LABORATORY

Interior photo shows two-story room with important features, a high door and removable intermediate floor to permit varying uses. Research in this laboratory is conducted in mechanical engineering, electronics, electrical engineering and the properties of matter.





POWERS

AUTOMATIC SYSTEMS OF

Temperature Control

On the Harvard campus are to be found some of America's most beautiful buildings. A few of them which benefit from the maximum thermal comfort and fuel savings assured by POWERS control are illustrated here.

For more than half a century POWERS control has been renowned for its matchless ability to give many years of efficient economical service. Users often report 25 to 50 years of reliable control with a minimum of repairs.

Experience gained here and in thousands of other famous buildings qualifies POWERS to help you select the most economical and efficient temperature control for your buildings. When problems of temperature control arise, call our nearest office or write us direct.

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in 60 cities in U. S. A., Canada and Mexico*

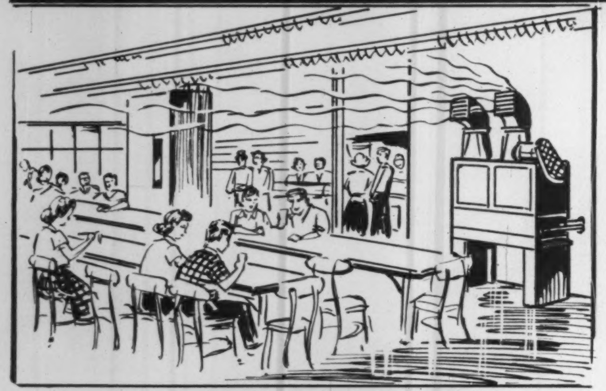
POWERS CONTROL

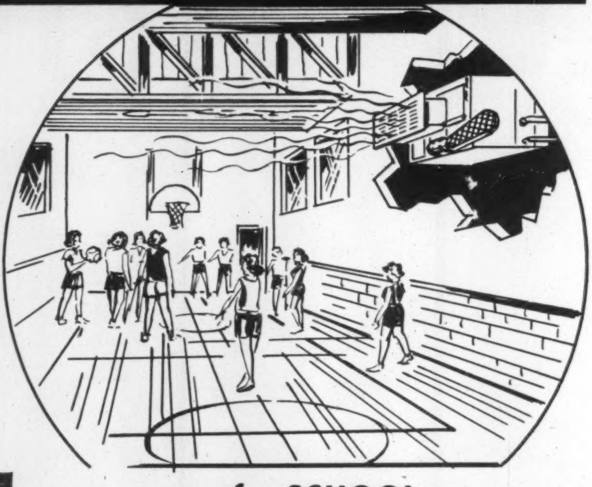
Over 60 years of Automatic Temperature and Humidity Control

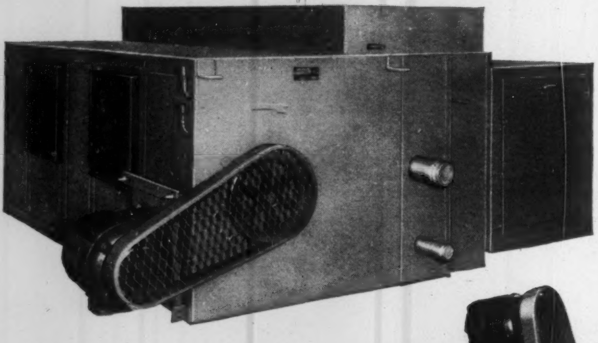
(b85)

KENNARD *Engineered*

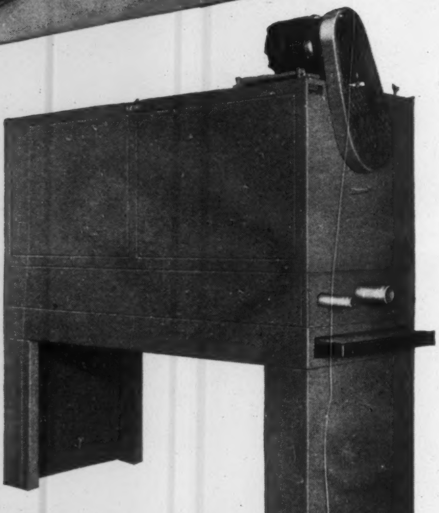
HEATING AND VENTILATING BLOWER UNITS







Wall or Ceiling Unit



Floor Unit

for SCHOOL...

AUDITORIUMS • CAFETERIAS • GYMNASIUMS
MANUAL TRAINING ROOMS
Models for Factories • Offices • Stores

Floor, Wall or Ceiling Arrangements, these units can be furnished with tempering or heating coils or combination of both for use with hot water or steam and the accessories for controlling, filtering and directing air flow.

There is a Kennard H & V Unit that will fit your requirement of heating and filtering recirculated air, fresh air, a mixture of both or for ventilation only.

TYPICAL CAPACITIES

Unit No.	CFM at 800 FPM Coil Face Velocity	CFM at 500 FPM Coil Face Velocity	Maximum BTU Capacity 2 Row Coil
107	864	540	59,700
108	1,264	790	87,300
110	1,832	1,145	126,800
111	2,896	1,810	199,800
210	4,000	2,500	276,700
211	5,696	3,560	392,900
213	6,880	4,300	475,500
215	8,936	5,585	616,700
216	10,336	6,460	713,700
218	12,680	7,925	875,100
220	15,000	9,375	1,035,500
223	19,800	12,375	1,366,900
226	28,800	18,000	1,988,400

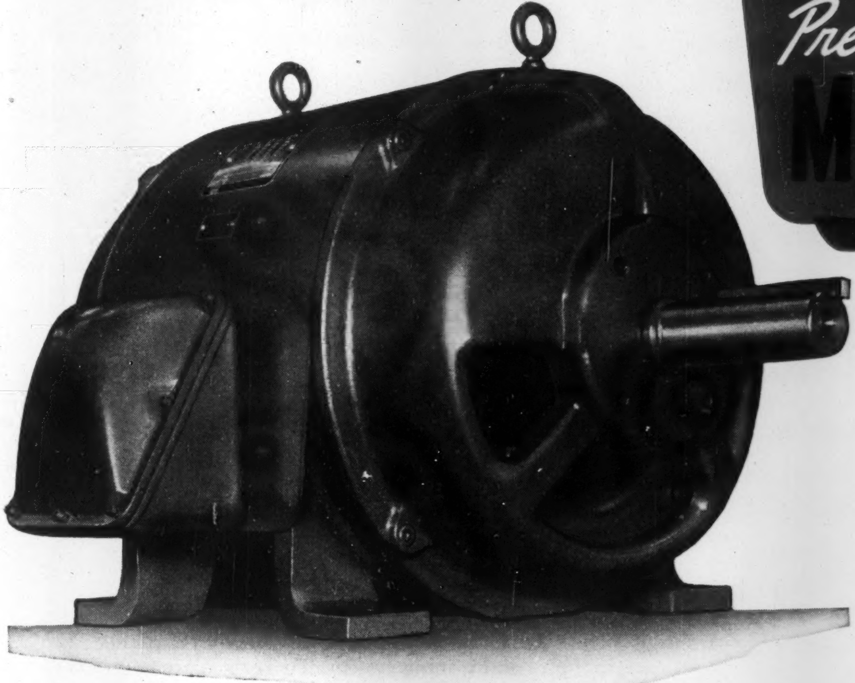
Write for Bulletin HV-1A

KENNARD CORPORATION
1817 HANLEY RD. • ST. LOUIS 17, MO.

FOR FAN SERVICE...

"All motors are NOT alike!"

RELIANCE
Precision-Built
MOTORS

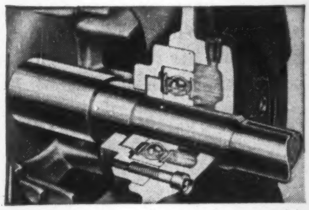


Reliance Protected Open A-c. Motor. All other standard enclosures available, with wide choice of mechanical designs and special mountings. Ratings from ¾ to 300 hp.

☆ **Low starting currents... liberal ratings**

☆ **Smooth acceleration... quiet operation**

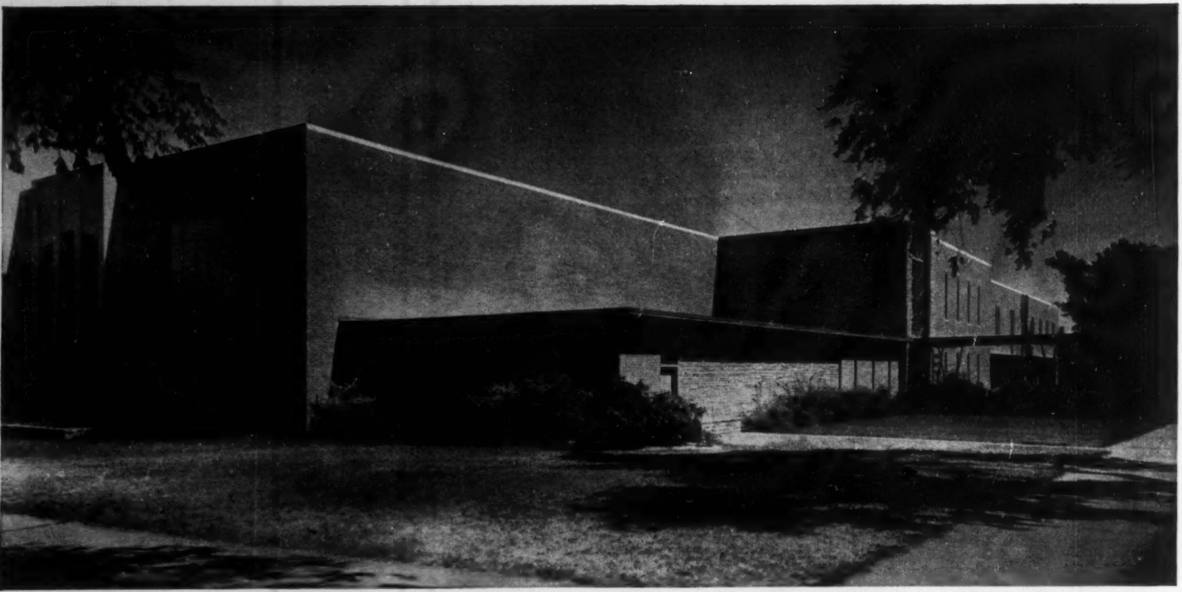
☆ **Tough, vibration-proof Reli-X insulation**



. . . AND THE BEST PRE-LUBRICATED BEARING DESIGN
The Reliance pre-lubricated bearing provides *four times more operating hours without re-lubrication* than any other bearing used in motors today. And—whatever your lubrication schedule—*you just can't grease'em wrong!* To get the complete "inside story" on motor bearings, write today for Bulletin B-2201. It contains hard facts on the advantages of the Reliance pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. B-1458D

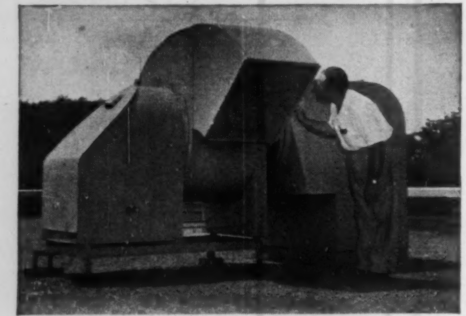
RELIANCE ELECTRIC AND ENGINEERING CO.

1052 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*



St. Luke's Methodist Church, Oklahoma City, Okla., is strikingly modern and uses American Blower equipment. Coston & Frankfurt, architects and engineers. Mid-Continent Mechanical Contractors, Inc., air-conditioning contractors.

American Blower helps write happy ending to St. Luke's air-conditioning problem



American Blower Exhaust Fan on roof gets rid of stale air from attic of St. Luke's main auditorium. Similar American Blower Fans on roof handle air from church cafeteria and rest rooms.

American Blower Air Conditioner on second floor services recreation room. For full data on American Blower equipment, contact your local American Blower representative, or write us direct.

Ultra-modern St. Luke's is one of the most popular churches in Oklahoma City—but its very popularity caused a revamping of its air-conditioning system!

St. Luke's Methodist Church, Oklahoma City, Okla., had a problem. Long operational schedules overburdened the original air-conditioning system. To keep apace of growing church needs, the entire setup had to be revamped. And, as is more and more the case, American Blower equipment was selected for the job.

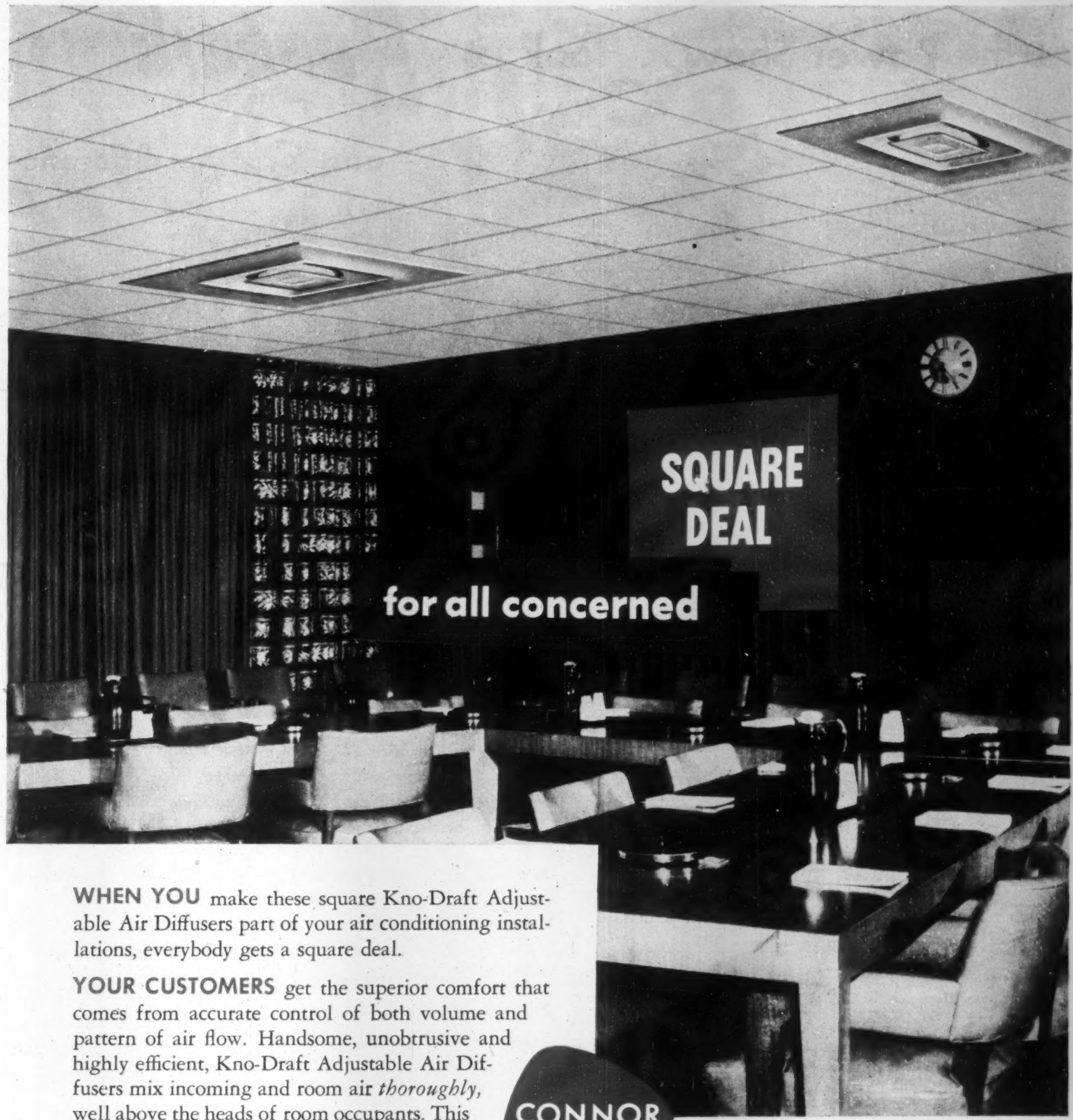
American Blower Air Conditioners – plus Cooling Coils, Heating and Ventilating Units, Supply and Exhaust Fans – were installed to furnish clean, fresh air for St. Luke's 20,000 sq. ft. of floor space: auditorium, sanctuary, study rooms, game rooms, kitchens and hallways . . . giving more than enough air-conditioning capacity for present and *future* requirements.

Do *you* have an air-conditioning or air-handling problem? Give your nearest American Blower or Canadian Sirocco Branch Office a call, today. American Blower engineers have a complete knowledge of the air cycle, and can supply equipment to meet the special problems of many industries.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



WHEN YOU make these square Kno-Draft Adjustable Air Diffusers part of your air conditioning installations, everybody gets a square deal.

YOUR CUSTOMERS get the superior comfort that comes from accurate control of both volume and pattern of air flow. Handsome, unobtrusive and highly efficient, Kno-Draft Adjustable Air Diffusers mix incoming and room air *thoroughly*, well above the heads of room occupants. This means even temperature throughout the conditioned area — *no drafts.*

YOU have more to offer and less "engineering" to do. Kno-Draft Diffusers are adjustable *after* installation. This means less slide-rule work *before* the job goes in. It also means easy resetting to accommodate future layout changes. Installation in any type of ceiling is quick and easy.

You can get Kno-Draft Adjustable Air Diffusers in round as well as square units. For complete specifications, engineering and installation data, send for the Kno-Draft Data Book. Just clip the coupon to your letterhead and mail to Connor Engineering Corporation, Danbury, Connecticut.

CONNOR

kno·draft®
adjustable air diffusers

see our catalog in
ARCHITECTURAL FILE
or write for copy

CONNOR ENGINEERING CORP.
Dept. G-114, Danbury, Connecticut

Please send me the latest edition of the Kno-Draft Data Book. No obligation, of course.

Name..

Position..

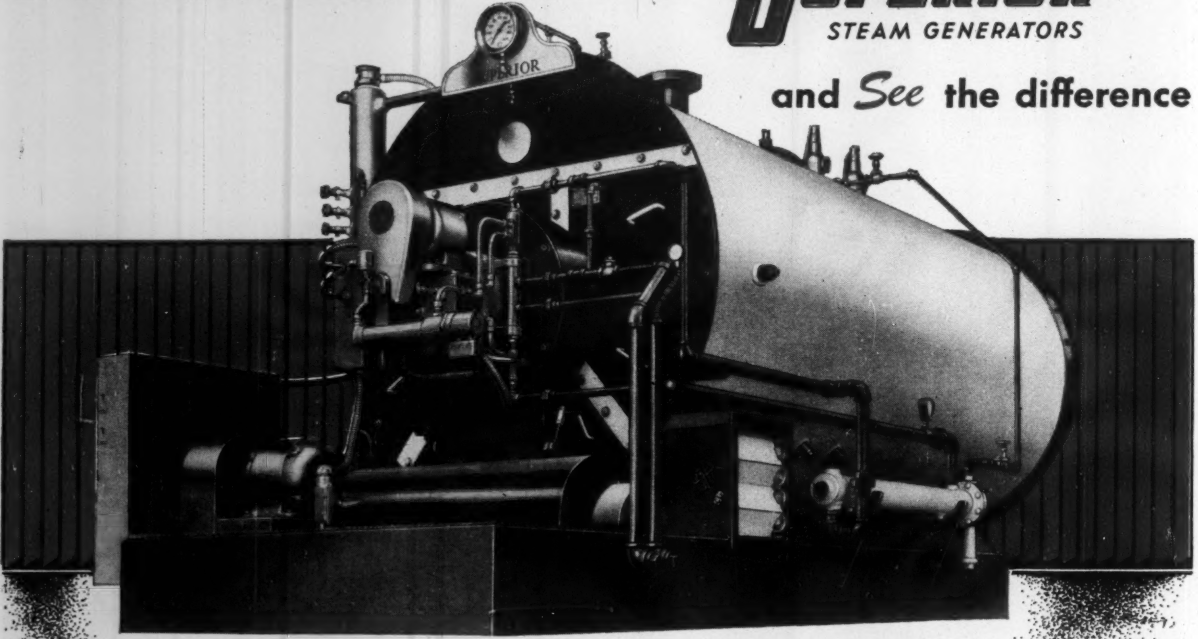
Company..

Street..

City.......................................Zone.........State.........................

at the Power Show . . . look at SUPERIOR STEAM GENERATORS

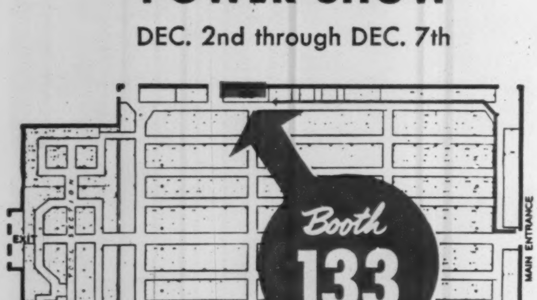
and *See* the difference



HERE'S WHAT TO LOOK FOR:

POWER SHOW

DEC. 2nd through DEC. 7th



COMMERCIAL MUSEUM
PHILADELPHIA

Look . . . at Superior's 4-pass fire-tube design . . . ample heating surfaces with a minimum of 5 sq. ft. per b.h.p.

Look . . . at Superior's built-in multiple induced-draft fans . . . drawing evenly across the entire tube area, and eliminating the need for an expensive chimney.

Look . . . at Superior's Rotary Burner with its own fan supplying primary air . . . fully automatic with oil or gas, or both . . . change from either fuel to the other quickly, without dismantling equipment or interrupting steam supply.

Look . . . at Superior's safety features . . . induced draft which prevents the escape of combustion gases into the boiler room . . . fool-proof combustion gas pressure-relief port . . . constant gas pilot throughout gas firing periods . . . dual purging of all gas passages, both before and after firing.

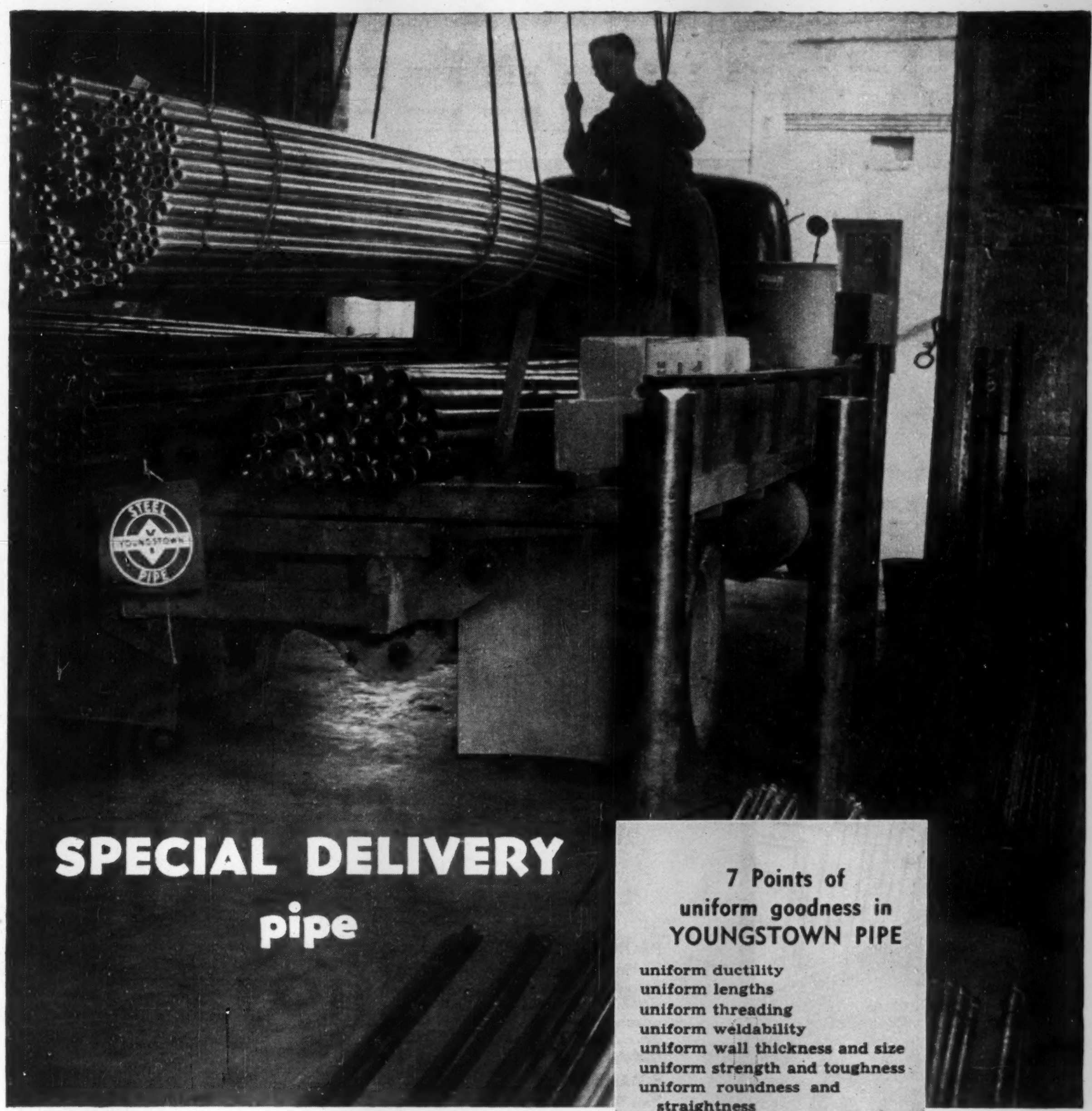
Look . . . at the overall picture . . . a complete packaged steam plant. One purchase shipped completely assembled after factory test to assure dependable operation at a guaranteed thermal efficiency of more than 80%.

Look . . . at Superior's catalog for the complete story. If you're not going to the show, write for Catalog 604.

for performance you can ***BANK*** *on*

SUPERIOR
STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.



7 Points of uniform goodness in YOUNGSTOWN PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

It's SPECIAL DELIVERY all the way when you order pipe from your Youngstown Pipe Distributor. In no time at all, he's got your order loaded and speeding to your door — or wherever you want it — any size — any amount!

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QUALITY
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THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

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In The "Buffalo" Fan Balancing Room

"BUFFALO
IDEA
FILE"

THE IMPORTANCE OF MAINTAINING BALANCE OF FAN WHEEL

PROBLEM:
excessive vibration in exhaust fan delivering dust-laden air to cyclone. Fan operated smoothly a number of years, but gradually developed vibration and finally damaged the bearings.

SOLUTION:
Fan Wheel found to be far out of balance due to uneven buildup of slightly moist dust particles on blades. Fan rotor had never been cleaned, and had condition been permitted to continue, further bearing troubles and a sprung shaft might have resulted. "Buffalo" representative advised owner to clean rotor every six months, then check wheel balance. Fan has since operated smoothly, with no further bearing trouble, and at greatly reduced noise level. NOTE: all "Buffalo" fan rotors are balanced both statically and dynamically on precision balancing machines at the factory. Regular periodic cleaning and repainting followed by a balance check will assure added years of smooth, efficient performance.

This is one of the thousands of problem - solution case histories accumulated in "Buffalo" files during our 77 years of building air handling equipment and solving air problems for industry. Call your nearest Buffalo Engineering Sales Representative — get the benefit of his factory trained "know-how" and experience to help you solve your air problems.

Write for Maintenance Data Booklet 3426.

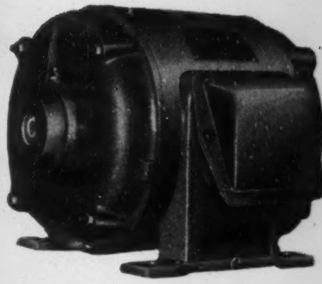
"Buffalo"

BUFFALO FORGE COMPANY
171 MORTIMER ST. BUFFALO 4, N.Y.
Publishers of "Fan Engineering" Handbook
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING FORCED DRAFT AIR CLEANING COOLING AIR TEMPERING HEATING INDUCED DRAFT PRESSURE BLOWING EXHAUSTING

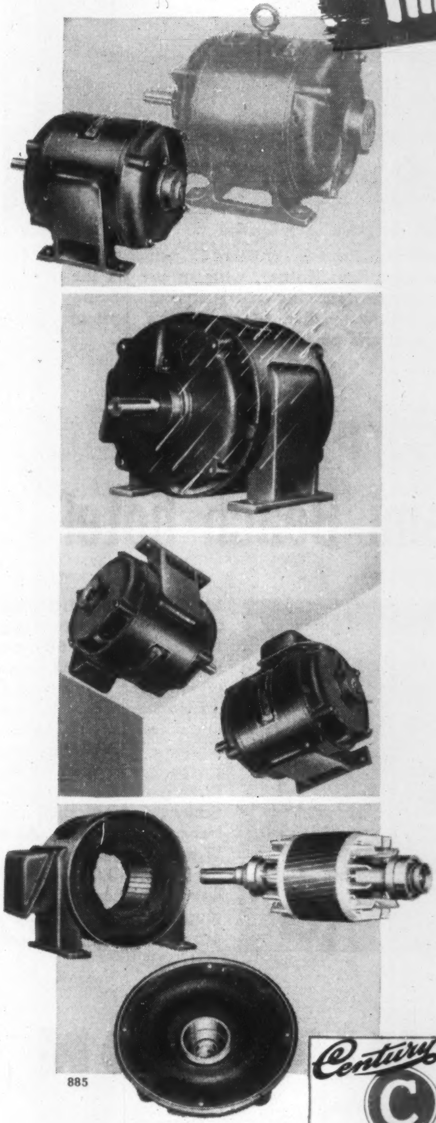
NEW *Century* Performance-Rated©

INTEGRAL H.P. MOTORS



Now available in
1 . . . 1½ . . . 2 H.P. sizes—
NEMA frames 182 and 184.

Improved Motors to match your needs



SMALLER — LIGHTER

More uniform silicon-laminated steel; thinner, *tougher* "Mylar" slot insulation — just two of the many technical developments that help make these new Century Performance Rated Motors so much *smaller* and *lighter.*

BETTER PROTECTION

New concepts of internal motor ventilation permit end bracket and frame design that gives far better protection from falling liquids and solids . . . still maintain 40°C. temperature rise.

MORE FLEXIBLE MOUNTING

You can even have cushion mounting with these new Century Integral H.P. Motors — your choice of sleeve or ball bearings. Ball bearing motors mount vertically, upside down, in any position. End brackets can be rotated for floor, ceiling or side wall mounting.

EVEN MORE DEPENDABILITY

Improved plastic impregnating varnish and plastic insulated magnet wire provide unusual resistance to abrasion, moisture and heat. These new materials possess far better dielectric qualities. Die cast aluminum rotors are individually, dynamically balanced to assure freedom from vibration.

Century C MOTORS

Specify CENTURY Performance Rated motors for your equipment. Call a Century District Sales Office or your nearest Century Authorized Distributor.

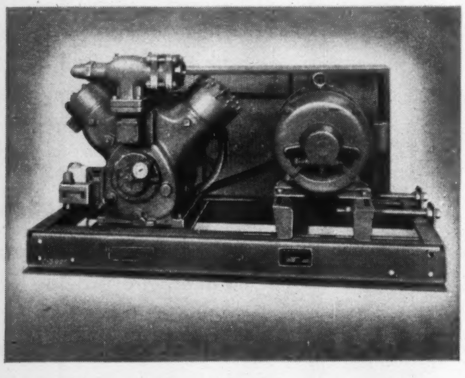
Offices and Stock Points
in Principal Cities

CENTURY ELECTRIC COMPANY • 1806 Pine Street • St. Louis 3, Missouri

THE STERLING, MIAMI BEACH'S NEWEST waterfront hotel, enjoyed a banner first season last winter. Owner David Rosner assigns a good share of the credit to his Worthington-engineered air conditioning system which cools the 142 rooms and 186,000 cubic feet of dining and lobby space. "Maintenance service (routine checkups) couldn't be better," says Manager Sam Rosner, with an eye on the potential business losses (running into thousands of dollars) that might follow mechanical breakdown. System includes both central and packaged air conditioners.

Worthington teams central and packaged air conditioners to cool new Miami Beach hotel

7½-TON, 3-TON, AND 1½-TON PACKAGED AIR CONDITIONERS with the famed Freon compressor like this serve as booster units to keep Sterling's crowded bar, television and card rooms cool without over-cooling other areas. Write for facts to Worthington Corporation, Air Conditioning and Refrigeration Div., Section A.4.50, Harrison, N.J.



BASIC AIR CONDITIONING UNIT for the Sterling Hotel is this 60-ton Worthington Freon compressor, end product of a million-dollar research program. Worthington equipment includes two Freon compressor units, three packaged air conditioners, and one shell and tube condenser. And Worthington's special cut-off system keeps power costs low when only minimum temperature changes are required. A.4.50

WORTHINGTON

Climate Engineers to Industry, Business and the Home

TRION

ELECTRONIC AIR CLEANERS

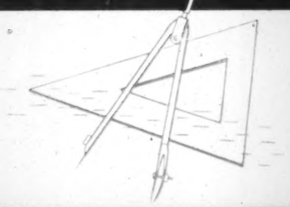
keep customers happy!

TRION

CLEAN AIR

Trionized Air—air that is 90% free of all airborne particles such as dust, dirt, soot, pollen and smoke—is helping thousands of industrial and commercial plants enjoy improved working conditions, cleaner merchandise and furnishings, protection of precision instruments and more hygienic atmosphere.

FINE DESIGN



Trion Electronic Air Cleaners contain no moving parts, are lightweight and can be easily stacked for large installations. They are smart in appearance, easy to install, low-cost in operation and require practically no maintenance.

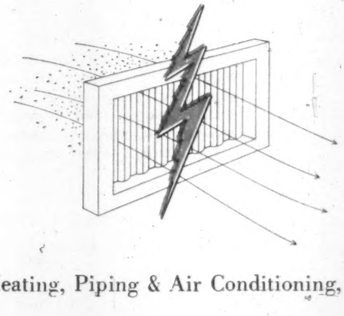
COUNTRY WIDE SALES and SERVICE

Trion sales and service engineers are located in every major trading area in the United States and abroad. These men are fully qualified to discuss the proper size and type of equipment needed for cleaning the air—anywhere.

Our free catalog E-60 tells the whole story—why not write for it today!

Consult phone directory Yellow Pages under "Filters—Air."

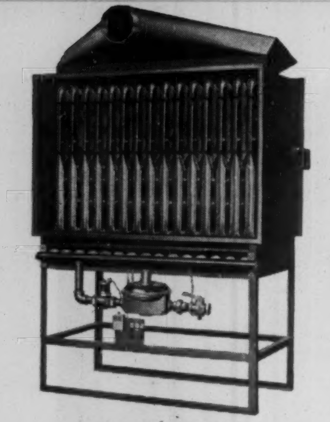
TRION



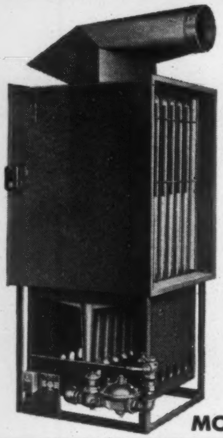
TRION, INC.

1000 Island Avenue • McKees Rocks, Pa.

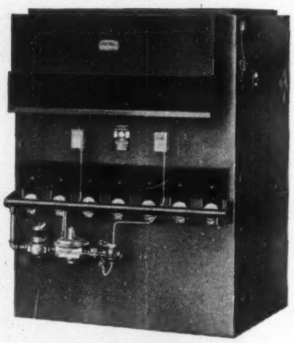
IN METROPOLITAN PITTSBURGH



MODEL SED-E



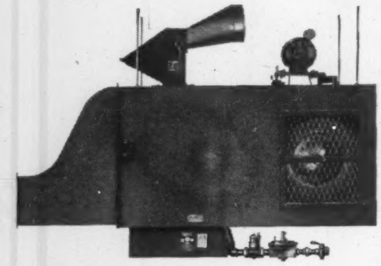
MODEL SED-S



MODEL SED-VF

MODEL SED-E — Non-corrosive type 321 stainless steel heat exchanger. Permits installation downstream of cooling equipment, for continuous blower operation. Air throughput in either direction. 80,000 to 600,000 Btu input.

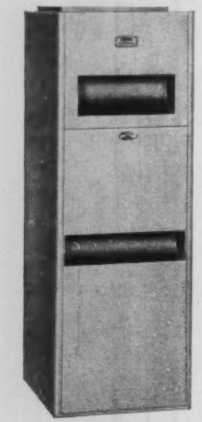
MODEL SED-S — Same as SED-E except controls are at the side, instead of at the end where accessibility requires either SED-E or SED-S is available in sizes from 80,000 to 600,000 Btu input in increments of 40,000 Btu.



MODEL SEU

MODEL SED-VF — Tested and approved as a duct furnace; type 321 stainless steel. Re-circulated or fresh air enters through bottom, sides, or back. Built in air bypass, vent in front. Sizes from 70,000 to 245,000 Btu input.

MODEL SEU — Suspended unit heater. Recirculates room air. Diffuser outlet with adjustable vertical and horizontal vanes. Double inlet forward curve blower. Continuous duty variable pitch drives, raised port burners.



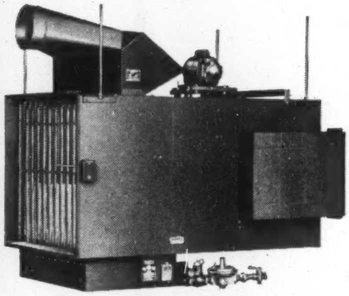
MODEL SEC

HAYES

FURNACES

outstanding for
commercial, industrial,
schools, churches,
theaters, large residential

HAYES FURNACE MFG. & SUPPLY CO.
2929 So. Fairfax Ave., Los Angeles 16, California
Telephone TExas 0-3734



MODEL SES

MODEL SEC — Forced air furnace. Stainless steel heat exchanger sections seam and arc welded. One piece cast iron burners with drilled ports. Oversize double inlet blower glass or washable filters. 6 sizes — 70,000 to 245,000 Btu input.

REPRESENTATIVES

M. Blazer & Son, Passaic, New Jersey.
Blue Flame Supply Company, Atlanta, Georgia.
Eugene Bolstad, Edmonton, Alberta, Canada.
E. B. Bomar, Phoenix, Arizona.
Boyd Engineering Co., Albuquerque, New Mexico And El Paso, Texas.
Reube O. Emery, Nashville, Tennessee.
Leudecke Engineering Co.. Austin. Texas.
McCombs Supply Co., Denver, Colorado.
J. M. O'Connor Co., Wichita, Kansas.
O'Connor-Oklahoma Co., Oklahoma City and Tulsa, Oklahoma.
Smith Steam Specialty Co., Kansas City, Mo.
Tay-Holbrook, Inc., San Francisco, California.
F. R. Young, Houston, Texas.
Associated Refrigeration Engineers, Montgomery, Alabama.
Dealers Supply Company, Atlanta, Georgia.
Jewell & Company, Hot Springs, Arkansas.
Homer Maxey & Company, Lubbock, Texas.
Noland & Co., Newport News, Va.

MODEL SES—Forced air, suspended furnace for installation in suspended duct system. Inlet and outlet designed for sheet metal duct connection. Double inlet forward curved blower. Continuous duty variable pitch drives, raised port burners.

Series 100 Open Motors are lighter in weight and take up to 30% less space than open motors of old NEMA frame sizes.

Series 100 TEFC Motors have same diameters as the Series 100 Open Motors, for easier interchangeability.

New Howell Series 100 open and TEFC motors have same diameters!

Howell's new re-rated motors save space, are easier to interchange! Feature double-shielded bearings . . . serve your needs better *all* ways.

If space ever limited your use of motors, here's welcome news: Series 100 Open and TEFC Motors have the same diameters! The reason? – Howell's exclusive ventilating system. This system cools *internally* providing 50% more contact between cooling air and active lamination materials. Result: you get motors that meet minimum space requirements . . . that run cooler than established ratings . . . that have increased load capacities – you get improved performance and longer life!

Less maintenance, too! New double-shielded bearings are standard on both the open and TEFC motors. These bearings seal grease in – dirt out. And where operating conditions are severe, you can re-grease them quickly, easily. Actual use proves these double-shielded bearings best for most applications; however, any type can be furnished.

Meet your special needs! New Series 100 Motors provide dependable copper rotors – three diameters for each frame size to assure design flexibility. Special corrosion-resistant materials and fittings are available.

Before you buy any re-rated motor, compare Howell's Series 100 Motors – for modern design, outstanding performance and precision engineering. Howell will continue to make a complete line of regular and special motors—with over 20,000 electrical design specifications to serve you. Call your Howell man today or write for Bulletin N-100!

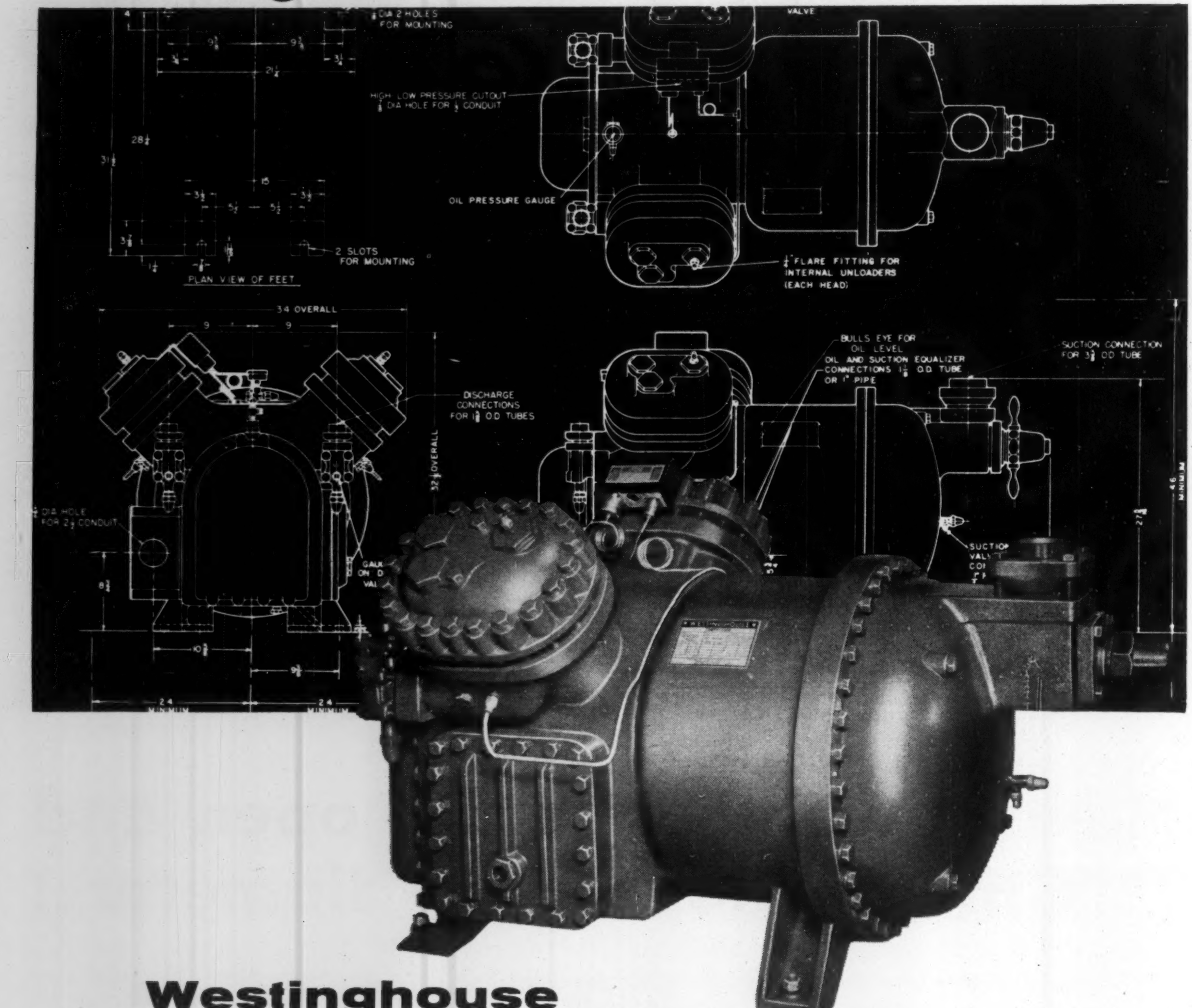
HOWELL
Red Band
MOTORS

HOWELL MOTORS

Howell Electric Motors Company, Howell, Michigan

MOTORS FOR INDUSTRY SINCE 1915

Design for Profit


DIA 2 HOLES FOR MOUNTING
HIGH LOW PRESSURE CUTOUT
DIA HOLE FOR CONDUIT
OIL PRESSURE GAUGE
2 SLOTS FOR MOUNTING
PLAN VIEW OF FEET
VALVE
FLARE FITTING FOR INTERNAL UNLOADERS (EACH HEAD)
34 OVERALL
DISCHARGE CONNECTIONS FOR 1⅝ O.D. TUBES
BULLS EYE FOR OIL LEVEL
OIL AND SUCTION EQUALIZER CONNECTIONS 1⅛ O.D. TUBE OR 1" PIPE
SUCTION CONNECTION FOR 3⅛ O.D. TUBE
DIA HOLE FOR 2½ CONDUIT
32½ OVERALL
24 MINIMUM
46 MINIMUM

Westinghouse Hermetically-Sealed Compressors 2 to 100 hp

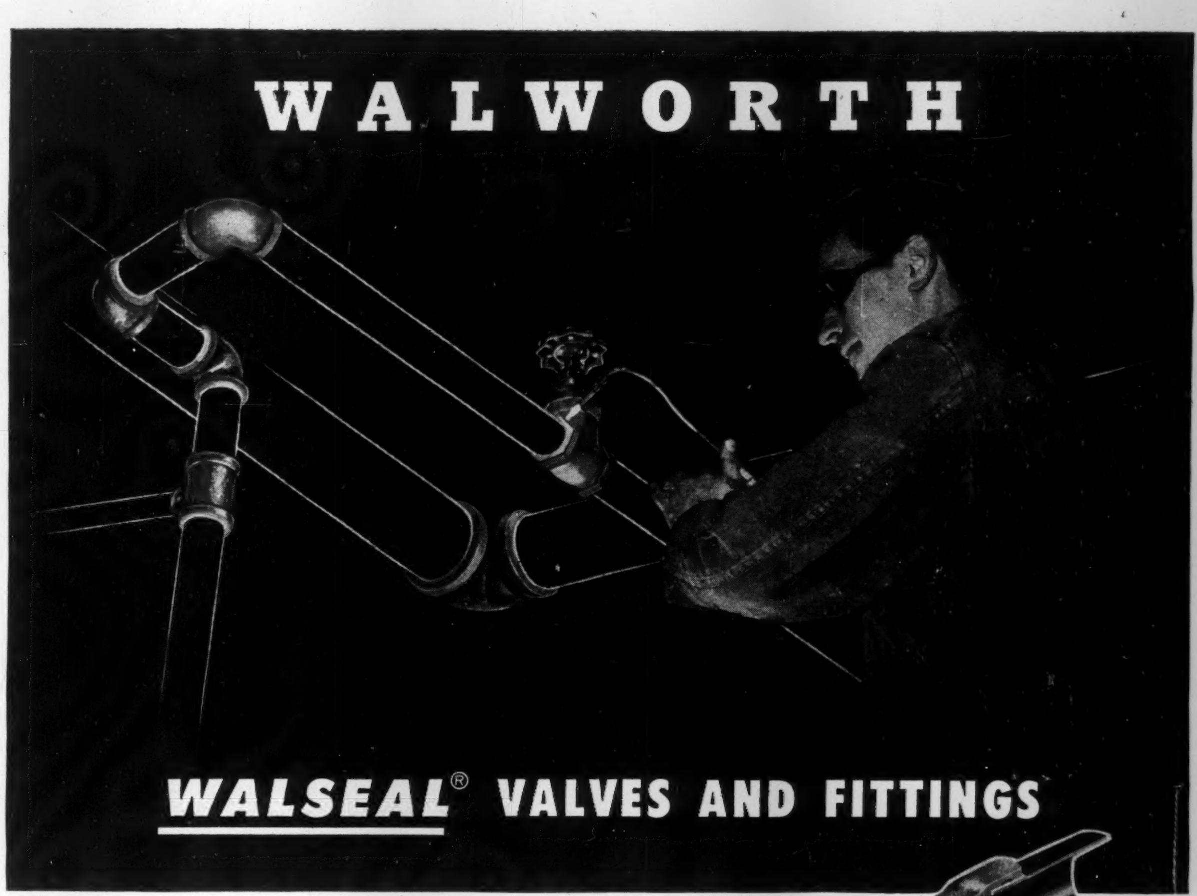
Capitalize on Westinghouse advanced compressor engineering. Easier to sell, easier to install and easier to service, the Westinghouse compressor line meets every market need—and has unmatched market acceptance. It is precision-built to provide low operating cost, long life and trouble-free operation. The refrigerant-cooled integral *motor* needs no ventilation. Belts, pulleys and shaft seals are eliminated. Moreover, size and weight are kept to a minimum—to lower installation costs.

Call the franchised Westinghouse Air Conditioning Distributor in your classified phone book, or write: Air Conditioning Division, Westinghouse Electric Corporation. Box 510, Staunton, Va.

WESTINGHOUSE AIR CONDITIONING

—YOU CAN BE SURE...IF IT'S Westinghouse—

J-80388



Cutaway view of a Walseal Tee showing: factory-inserted ring of silver brazing alloy; fillet of silver brazing alloy that appears upon completion of Walseal joint; cutaway view of the completed joint showing that silver brazing alloy has flowed in both directions from the factory-inserted ring.

***Better because*...** **There's no guesswork when a silver-brazed joint is made with a Walseal fitting. Sil-Fos alloy, which appears as a fillet at the face of a Walseal joint, comes from rings which have been factory-inserted in the end connections of Walseal fittings. The bright silver alloy fillet that you can see assures full penetration of alloy for a permanently leakproof joint.**

Walseal is a registered trade mark which identifies valves and fittings manufactured by the Walworth Company. Walseal products have factory-inserted rings of silver brazing alloy in threadless ports. Walseal joints can be made only with Walseal valves and fittings.

If you're piping water, oil, steam, air, oxygen, nitrogen, helium or other industrial gases or refrigerants through brass, copper, or copper-nickel pipe, you'll want to investigate Walseal — available in complete lines of valves and fittings in four distinct pressure ranges — from 0 to 5000 psi. working pressure*. Your copy of Circular 115 will be sent on request . . . see your near-by Walworth Distributor today, or write to: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

*Walseal fittings and valves are being used at sub-zero temperatures as low as —350 F.

Make it "a one-piece pipeline" with WALSEAL

SEE OUR CATALOG IN SWEET'S

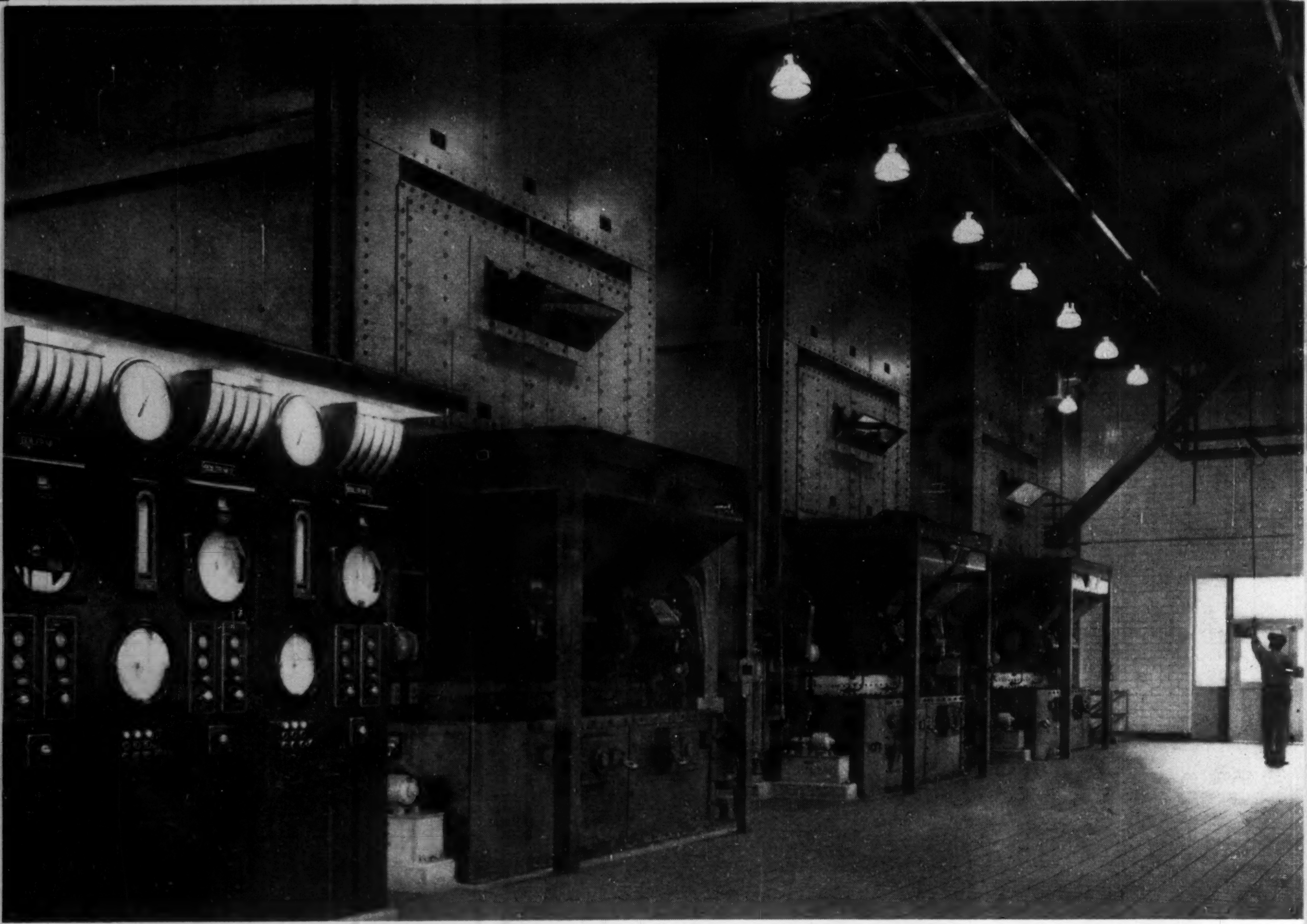
WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



For low-cost, dependable steam, Upjohn burns coal the modern way

Upjohn has long been famous as a manufacturer of pharmaceutical products. Because of the nature of these products, it was necessary that the steam plant of Upjohn's new Portage Road Plant, near Kalamazoo, Michigan, operate cleanly as well as economically. Therefore, coal was chosen to fire its boilers.

Today Upjohn's ultramodern steam plant supplies steam at only 40c to 42c per 1,000 pounds. It is clean and efficient, with no dust or smoke nuisances, and ash handling is fully automatic. At peak load, the three boilers shown above, plus a fourth recently installed, deliver up to 115,000 lbs. of steam per hour.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can cut your labor cost to a minimum.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

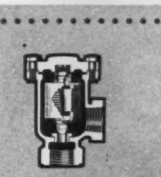
Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE

A department of National Coal Association • Southern Building, Washington 5, D.C.

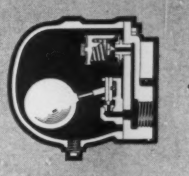
Which type of steam trap is best for *your* need?



1

Sarco Balanced Pressure Thermostatic

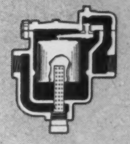
Greatest capacity per dollar cost. Large air venting capacity. Same head and seat, 0-300 psi. Freeze-proof. Cat. 250-A



2

Sarco Float-Thermostatic

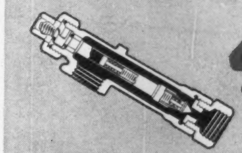
Discharges condensate continuously at steam temperature and without shock. Responds immediately to varying loads and pressures. Cat. 450-A



3

Sarco Camlift Bucket

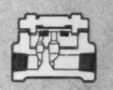
New, powerful Camlift valve mechanism permits greater discharge with no increase in size of trap body. Cat. 360-A



4

Sarco Liquid Expansion

Adjustable to discharge condensate below 212°F. Freeze-proof. Not affected by water-hammer or pressure pulsations. Cat. 260-A



5

Sarco Thermodynamic

Valve head, a solid stn. st. disc, is only moving part. Same head and seat to 600 psi. Not affected by superheat, water-hammer, corrosive condensate. Cat. 255-A

With these 5 different types to offer, Sarco can give you impartial advice

Any type of steam trap will do "some kind" of a steam trapping job for you.

But there's a world of difference in trapping efficiency when exactly the *right* type of trap is used for a given application.

That's because both trapping conditions and the characteristics of different types of traps vary widely. There simply isn't any *one* type of trap that will do an efficient job under *all* circumstances. But there is always a particular type of trap best suited for each *specific* set of conditions.

That is why Sarco makes all 5 basically *different* types of traps. In a nutshell, it's to assure you of best trapping results at all times, regardless of requirements.

And don't overlook the very important fact that *only* Sarco makes all these 5 types — not merely variations of one type. Therefore, Sarco can give you absolutely impartial trapping recommendations, backed by 43 years of field experience. Call your local Sarco representative or write:

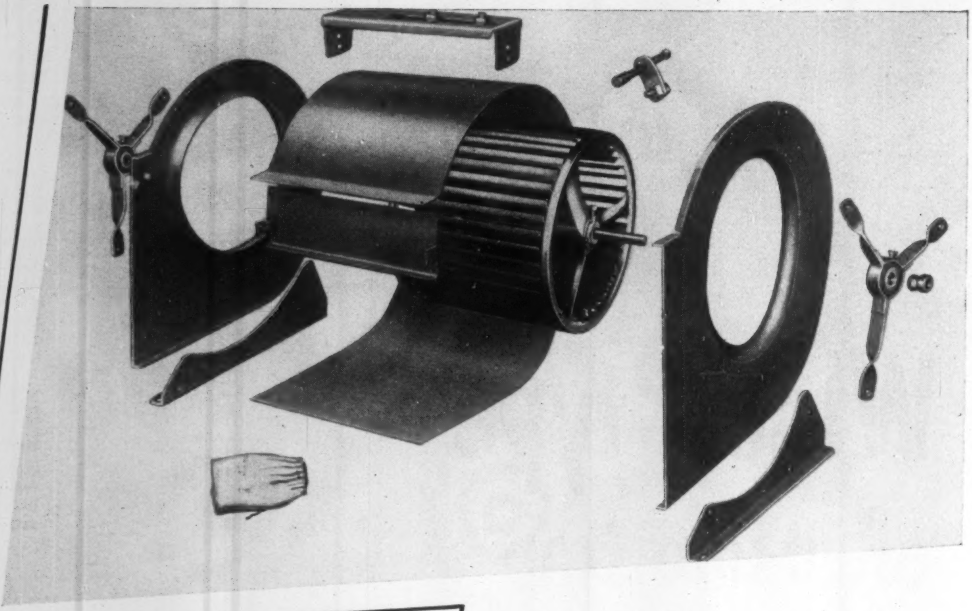
SARCO COMPANY, INC., Empire State Building,
New York, N. Y. Represented in Principal Cities.

2083-C

ONLY SARCO makes all 5 types of traps

—not merely variations of one type!

SARCO SAVES STEAM



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Whether you buy MORRISON Parts and build your own Blower Assemblies or buy complete Blowers, you get MORRISON quality and design . . . the advantage of MORRISON unequalled engineering "know-how".

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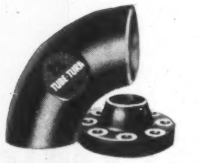
You can make piping dollars go further by doing business with your Tube Turns' distributor. For it is through this nearby source that you have access to the world-famous Engineering Service Division of Tube Turns. The help of its experienced engineers often saves thousands of dollars in piping costs.

You get this service and other important plus values only when you purchase TUBE-TURN* Welding Fittings and Flanges. Your Tube Turns' distributor has the world's most complete line to match your needs and save your time.

The Leading Manufacturer of Welding Fittings and Flanges



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A DIVISION OF NATIONAL CYLINDER GAS COMPANY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Tulsa
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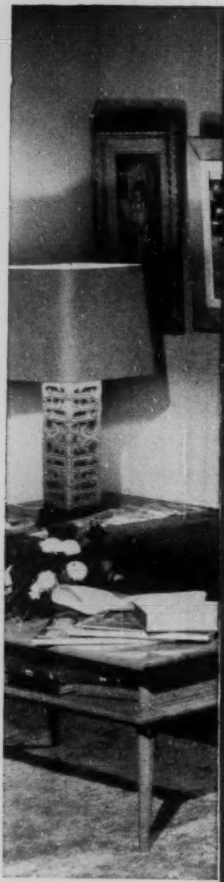

FEDDERS CONVECTOR RADIATORS

with new slide-in front

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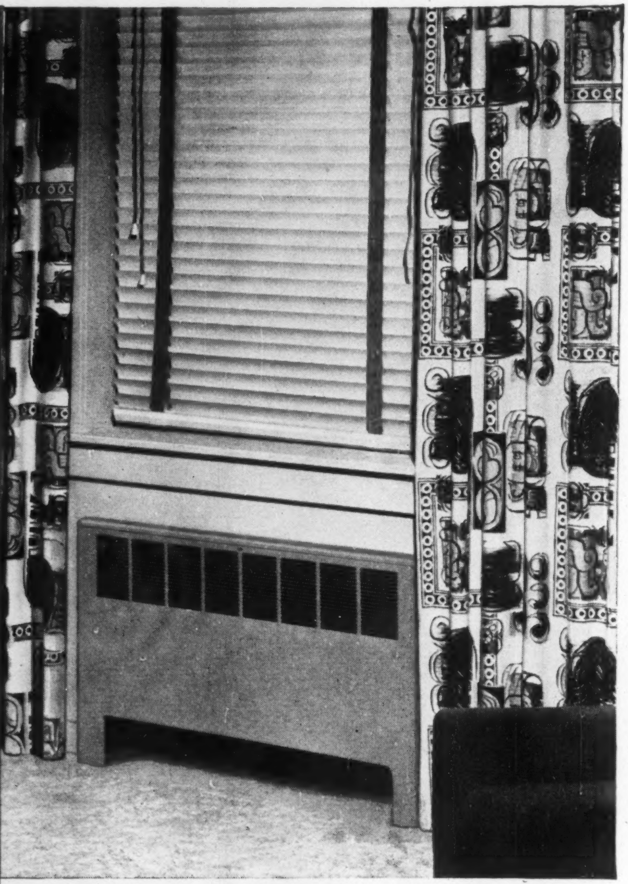
make installations quicker easier better looking



● New quick installation and new beauty have been designed into Fedders free-standing and semi-recessed Convector-Radiators with the new slide-in front panels.

Simply slide front panel into place and snap shut... no holes to line up... no screws to drive or lose... on or off in a second! Saves tempers and time, especially on apartment building and multiple housing jobs.

New beauty too... no unsightly screws to mar their smooth appearance or finish.

NEW FEDDERS TYPE F, FE and FB CONVECTOR-RADIATORS with Slide-in Front

Quick, easy installation ... smooth front panels, no screws. Complete line of other models for free standing, recessed and picture window installations

Fedders Convector-Radiators are styled to harmonize with modern interiors. Free-standing, or semi-recessed or flush mounted, they are ideal for new construction or remodeling. Long low picture window models too!

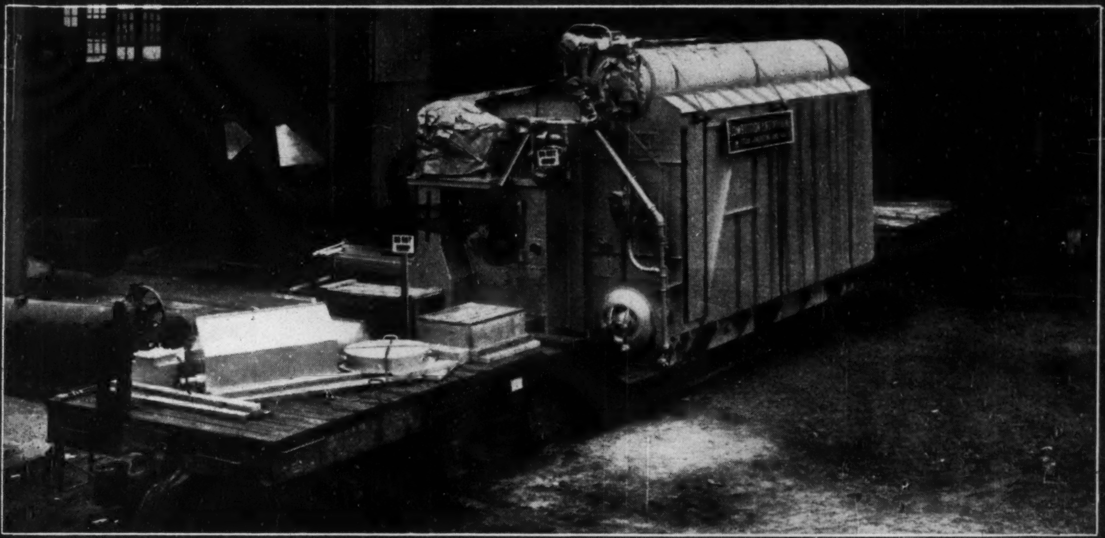
Heating elements made of copper tubes and aluminum fins assure high heat transfer efficiency and quick response to thermostatic control. Combined radiant and convected heat maintains more uniform temperatures from floor to ceiling.

Write Dept. HP for Catalog CRG-C1.

Also manufacturers of Baseboard Radiation, Wall Radiation, Unit Heaters and other heat transfer equipment.

FEDDERS-QUIGAN CORPORATION
HEATING DIVISION
TRENTON 7, N. J.

NOW YOU CAN GET THE VP BOILER
UP TO 40,000 POUNDS PER HOUR CAPACITY



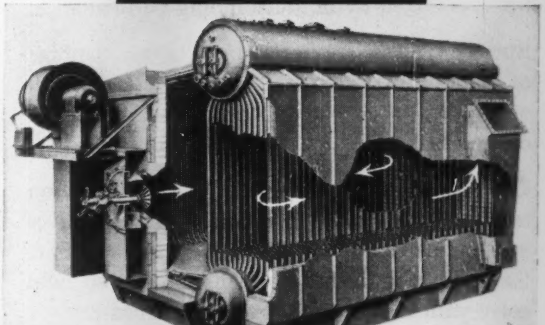
SPECIFICATIONS
of the VP Boiler

Capacity—4,000 to 40,000 pounds of steam per hour
Pressures—up to 500 pounds per square inch
Fuel—oil or gas
Erection—completely shop-assembled
Foundation—simple concrete slab

Now the many advantages of the C-E Package Boiler, Type VP, are available to you in an even higher range of capacities. For Combustion has added two new sizes—for capacities of 35,000 and 40,000 pounds of steam per hour.

No C-E Boiler has ever "caught on" more quickly or received more widespread and enthusiastic acceptance than the VP. This can only reflect the *plus* values of its Extra Features such as:

- More water cooling per unit of furnace volume than any other boiler of the VP's size and type.
- Quiet centrifugal fan, which operates at low speed and with an exceptionally low noise level.
- Large lower drum, which facilitates handling wide load swings . . . permits a simple, symmetrical tube arrangement . . . simplifies inspection.
- Single Burner — balanced furnace conditions are easier to get and to maintain . . . no duplication of burner control equipment . . . no air leakage through idle burner . . . change oil gun, when required, in seconds.
- Simple baffle arrangement, which means maximum heat transfer rate . . . no dead gas pockets . . . simplified soot blowing.



Consider, too, that many companies are discovering that they can get increased flexibliity—at lower cost—by meeting their entire steam requirements with two or more VP boilers rather than with a single, larger unit.

Why not investigate the extra values you can have with Combustion's VP Boiler. Send for your copy of Catalog VP-185 or, even better, have a C-E engineer discuss your needs with you or your consultants. No obligation, of course.

C-E

COMBUSTION ENGINEERING

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B774B

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS AND FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS, SOIL PIPE

AT THE VERY HEART OF FINE REPUTATIONS . .

AN **EMERSON ELECTRIC MOTOR**

AIR CONDITIONERS
FANS
OIL BURNERS
WASHING MACHINES
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FURNACE BLOWERS
EVAPORATIVE COOLERS
OFFICES MACHINES
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PUMPS
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UNIT HEATERS
REFRIGERATORS
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EMERSON ELECTRIC
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EMERSON ELECTRIC
SPLIT-PHASE MOTORS

The valuable extra you get with your Emerson-Electric motor

You probably know that the Emerson-Electric motor has helped to build more than one product reputation by its outstanding performance.

But are you aware that you can take advantage of the specialized experience and technical skill of Emerson-Electric Engineers and Designers on anything related to electric motors?

Often, a simple change in design or production technique can save you many dollars, deliver better performance for you. Remember, Emerson-Electric has specialists ready to help solve your most complex motor problems.

Write for information on this consulting service, or bulletins on Emerson-Electric's complete line of NEMA standard motors from 1/20 to 5 h. p. (Check Bulletin desired.)

- ☐ M442-A Capacitor-Start
- ☐ M442-B Split-Phase
- ☐ M442-C Integral
- ☐ M442-D Fan Duty
- ☐ M442-E Oil-Burner
- ☐ M442-F Jet Pump
- ☐ M442-G Blower

THE EMERSON ELECTRIC MANUFACTURING CO.
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MOTORS • FANS APPLIANCES

Why should YOU stock circulator couplings?

Since new Dunham Hot Water Circulators have a *single* spring coupling that never wears out under normal conditions, you can forget about stocking replacement couplings or replacing them! The single spring coupling in every Dunham Circulator is guaranteed for the lifetime of the circulator. But this is just one of the many reasons for the rapid rise in popularity of these compact, quiet circulators.

Dynetrically balanced, one-piece impeller is vibrationless at full rated capacity. Weep hole construction between self-centering, field replaceable seals and extra-large oil reservoir prevents water contamination of bearing lubrication section. Special, *brand-name* motor has built-in overload protection.

Dunham Circulators are easy to install, too . . . in horizontal or vertical pipes . . . in supply mains or return lines . . . regardless of boiler position. For further information on the Dunham complete hot water line, clip and mail the coupon.

NEW DUNHAM CIRCULATOR
Standard and high head capacities

DUNHAM **HOT WATER HEATING**

RADIATION • CONTROLS • UNIT HEATERS • PUMPS • SPECIALTIES

QUALITY FIRST FOR FIFTY-ONE YEARS

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Send complete Hot Water Line Literature.

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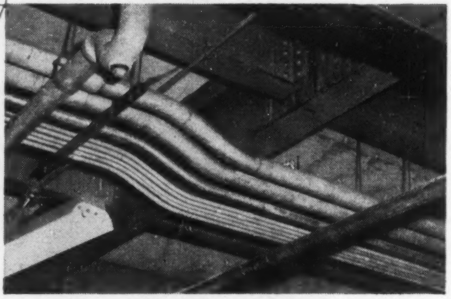
in Ortlieb's new bottling plant

a complete SPANG® CW STEEL PIPE installation



With 85 years' experience in the brewing business, Ortlieb Brewing Company, Philadelphia, knows what it takes to turn out quality beer and ale. Ortlieb brewers know that in order to make *top-quality* beverages you need *top-quality* ingredients.

The architects and contractors who constructed Ortlieb's new bottling house know that a building, too, is only as good as the materials which go into it. That's why they specified *top-quality* Spang CW Steel Pipe to handle the heating, plumbing and drainage for the new plant.

Like the products it serves, Spang CW Steel Pipe is a *quality* product . . . made from the highest-grade skelp . . . carefully controlled and inspected throughout production . . . and thoroughly tested before shipment. This care in manufacture assures you a product which is easy to cut, thread and bend . . . saving you valuable installation time and money.

Top-quality Spang CW Steel Pipe is available at no extra cost. Don't just buy pipe . . . buy Spang CW Steel Pipe for your next installation.

Write for complete information and for the name of your nearest Spang Distributor.

Owner: **Henry F. Ortlieb Brewing Co., Philadelphia, Pa.**
Architect, General Contractor and Piping Contractor:
W. F. Koelle Co., Philadelphia, Pa.
Spang Distributor: **H. B. Pancoast Co., Philadelphia, Pa.**

SPANG-CHALFANT
DIVISION OF THE NATIONAL SUPPLY COMPANY
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IMPROVED DESIGN!
WIDER RANGE!
SPENCER
TYPE "C"
SPENCER HEATER
WILLIAMSPORT, PA

SPENCER "C" BOILERS

For Larger Homes, Motels, Schools, Churches, Apartments Commercial and Industrial Buildings

Capacity Range: 1100 to 5000 sq. ft. steam net rating 1760 to 8000 sq. ft. water net rating

SPENCER'S

POPULAR "C" BOILERS NOW OFFER NEW FEATURES . . . NEW SIZES . . . MORE ATTRACTIVE PRICES!

Now, the most popular series in Spencer's quality line of boilers is available for a wider range of jobs . . . and at more attractive prices.

Improved design now makes this outstanding boiler available with standard 15″ base or extra base heights, at nominal charge, for special fuel-burning installations. Four new larger models, with heavy 3″ fire tubes, have been added to the line, providing greater range in application.

Here are some of the outstanding features of the Spencer "C" Boilers: water-cooled, precision-ground flue and fire-door frames, equipped with heavy cast-iron insulated doors; extra-heavy steel-plate smokeboxes; staggered boiler tubes for rapid heat transfer; service water-heating coils in many capacities.

Entire boiler line available with attractive standard jackets, insulated with glass wool, with beautiful blue-gray hammerloy finish.

Any fuel can be fired in the Spencer "C" Boilers. Easily and quickly converted from hand to automatic firing.

For any job—residential, industrial or commercial—requiring 1100 to 5000-sq.-ft. net load steam, low pressure, specify one of Spencer's "C" Series. *Save dollars and provide the highest quality heating plant available.*

SPENCER HEATER
LYCOMING DIVISION
WILLIAMSPORT AVCO PENNSYLVANIA

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Spencer Heaters—Dept. HP-114
Lycoming Division
AVCO Manufacturing Corp.
Williamsport, Pennsylvania

Dear Sirs:
Please send additional information and specifications on the new Spencer "C" Series Boilers to:

Name____________________
Position____________________
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ONE SURE WAY
TO SEE QUALITY
2X120X3'0''TYPE
ASTM A-178-51T B
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B&W TUBES ERW
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IN Welded Boiler Tubes

Babcock & Wilcox Tubes, Electric Resistance Welded appears not only as a means of identification, but as a *mark of value.*

It is a mark of many meanings. It signifies the qualities that must be present in a tube if the phrase "long service life" *means* what it says. Uniform wall thickness, high ductility, uniform diameter, ease of rolling in, pit and scratch-free surface, are some of the factors that make your choice of B&W Welded Boiler Tubes a lasting choice.

For three-quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for all pressures up to those approaching 3000 psi. The application of this extensive knowledge and experience results naturally in the production of finer welded boiler tubes.

If you want ease of fabrication and long service life for the tubing in *your* boiler, take the long view, choose B&W Welded Boiler Tubes.

B&W
SEAMLESS and WELDED
TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION

Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

TA-4068(CWP)

THE EDITORS' PAGES

The ASHVE Should Change Its Name To "The American Society of Heating and Air Conditioning Engineers"

In this month of November 1954, two important engineering societies — one of them being The American Society of Heating and Ventilating Engineers — are voting on whether or not to change their names to include the words "Air Conditioning." Each of the two is incorporated in the same state, and it is generally understood that if one society votes to change, the other may not be allowed by the state to do so.

Each society is operating under the same voting rules whereby, in order to make a change, a majority of members who are eligible to vote must vote in favor of the change. This means, in effect, that a failure to vote at all is almost a vote against the proposed change.

Too, the time before the ballots are to be counted is quite short, in both cases. Because of the voting rules and this shortness of time before the decision must be reached, it behooves all those who have the right to vote to exercise that right promptly. A failure to vote at all, or a failure to vote promptly, may mean that your wishes in the matter will have to be entirely disregarded.

So much for the "mechanics" of the two ballots, and the importance of the respective members exercising their voting rights promptly. What about the merits of the two proposals?

Why We Speak Up

The officers of each of the two societies are endeavoring to explain the pro's and con's to their respective memberships. It is felt, however, that the views of the editors of Heating, Piping & Air Conditioning — entirely independent of either of the two societies — will be helpful to both groups of members in arriving at their decisions. We, perhaps, may be considered particularly qualified to speak on such a matter, for Heating, Piping & Air Conditioning has included the words "Air Conditioning" in its title since the first issue in May 1929. Of the many associations and publications using today "Air Conditioning" as part of their names, the magazine Heating, Piping & Air Conditioning was the first. We are proud of the fact — with good reason, we feel sure — that back in 1928, when this magazine's first issue was being planned, we could foresee the inevitable growth in importance of air conditioning . . . and chose to recognize this in our title and our editorial scope.

A society, an association, a magazine or other organization can, of course, be named almost anything. But it is obvious that the name should recognize and reflect the scope and activities of the enterprise.

Air conditioning is a big subject, and organizations in many fields have a certain interest in it. To name but a few groups, the electric utilities, refrigerating engineers, water works engineers, automotive engineers and illuminating engineers all have an interest in air conditioning — as they do in other things, too. But to include the words "air conditioning" in the name of an organization indicates a primary interest in — and many contributions to — the development of air conditioning.

Pioneered Air Conditioning

When The American Society of Heating and Ventilating Engineers was founded, in 1894, the term "air conditioning" had not been coined. At that time, the words "heating and ventilating" pretty well defined the scope and activities of the ASHVE.

It was not long, however, before papers on subjects which are now generally and properly considered as phases of air conditioning began to be presented at ASHVE meetings. As far back as 1903, a paper on cooling an auditorium was given at the annual meeting. In 1904, there was a paper on the necessity of humidification, and in 1905 there was a discussion on indoor humidity. Such air conditioning papers and discussions became more numerous as the years went on, with subjects such as air washers, air cleanliness, the synthetic air chart, etc., being featured. And in 1917, J. Irvine Lyle's presidential address was titled "Effect of Air Conditioning on Munitions Manufacture."

As time went on, the ASHVE devoted more and more attention to air conditioning, and in its research work and papers over the years developed a great proportion of the data on which air conditioning practice, as we know it today, is based. It continues to do so in ever-increasing volume.

Members Do Air Conditioning

It is quite natural and logical that this has been and continues to be so, for it is the engineers and contractors of the type making up the membership of the ASHVE who do air conditioning work — designing and specifying the systems for plants and buildings, purchasing and installing the equipment, and operating and maintaining it.

The accepted definition of air conditioning states that it is the simultaneous control of (at least) temperature, humidity and air motion. Ventilation is defined as the process of removing or supplying air. Thus, the term "air conditioning" includes ventilation — but "ventilation" does not include air conditioning.

Because the ASHVE has pioneered in the development of air conditioning as it is known today, because its membership represents those who actually do air conditioning, and because the words "air conditioning" include ventilation, it seems to the editors of Heating, Piping & Air Conditioning that the name of The American Society of Heating and Ventilating Engineers should be changed to The American Society of Heating and Air Conditioning Engineers, as the ASHVE's own governing council has suggested. Note that the word "heating" is to be retained. Certainly, no other society or association has any better claim, based on the record, to the words "air conditioning."

Justified on Every Ground

All these things justify, on every ground, the proposed change. We can't help but think that, while there may be some who won't agree with our reasoning as to the desirability of the name change, it would be highly incompatible with the facts of the development and distribution of air conditioning for any other engineering society to be permitted to preempt the term. In other words, the importance of the ASHVE revising its name may be open to discussion — but not the importance of the ASHVE rather than some other group doing so.

Of course, if the change shouldn't go through, it doesn't affect the facts of air conditioning's development and distribution. However, the only objections we have heard to making the proposed change refer only to details, such as the mechanics — if it is necessary to do so at all — of revising the wording on existing membership certificates, changing stationery, etc.

Vote for the Change!

If you agree to the desirability of making the change, and if you are eligible to vote on the question, we suggest you cast your ballot promptly to change the name of The American Society of Heating and Ventilating Engineers to The American Society of Heating and Air Conditioning Engineers.

If you have misplaced your proxy form, write The American Society of Heating and Ventilating Engineers, 62 Worth St., New York 13, N. Y., today for another one so that you can vote. If you want to change your vote, write the ASHVE requesting the return to you of your previous proxy and ask them to send you another blank ballot.

Power Factors Established For Room Air Conditioners

. . . effective with 1956 models

INTER-INDUSTRY accord on recommended minimum factors for room air conditioners has been reached with the release of a report by the Joint Committee on Air Conditioning and Refrigerating Equipment of the Air Conditioning and Refrigeration Institute, Edison Electric Institute and National Electrical Manufacturers Association.

Established recommended minimum power factor values are based on unit size, calling for a minimum of 75 percent for 1/3 hp units, 80 percent for ½ hp, and 85 percent for ¾ hp and larger.

Power factors are to be measured at Underwriters' Laboratories under maximum normal load test conditions — 104 F DB and 80 F WB on both sides of the unit and 120, 208, or 240 volts — depending on the unit voltage rating — at the unit service connection. These recommended minimums are to be effective in the 1956 models.

"Quote"

"Big-building modernization will create one of the most spectacular of all marketing opportunities for the air conditioning industry during the next 10 years." — *Donald C. Minard, president of The Trane Co., in a luncheon talk to the New York Society of Security Analysts on October* 18, 1954.

Power Show To Be in Philadelphia

. . . December 2-7

FOR THE FIRST time, the National Exposition of Power and Mechanical Engineering is to be held in Philadelphia this year, December 2 through 7.

Equipment of every description used in the generation and distribution of power, including fuel handling and combustion, engines, generators, motors, pumps, compressors, mechanical transmissions, and electrical controls will be on exhibition. Boilers, from the smallest packaged types to those for big steam stations, will be shown.

Exhibits of raw and fabricated materials, including ferrous and nonferrous metals and alloys, plastics, and refractories will reflect present trends in power plant design. These point toward higher temperatures and pressures, higher rates of heat transfer and higher velocities of flowing gases and liquids. For these, increased strength and greater resistance to erosion, corrosion and wear are demanded, and new designs generally call for reduced cost of maintenance and longer life.

HPAC will be on hand at the show in Booth No. 415.

New $3-million Euclid-Glenville Hospital. Main building is at left. One-story wing at right houses administrative offices. Adjunct facilities are in 3-story wing at rear. Architect: Conrad and Simpson. Consulting Engineer: Vincent Eaton. Consultant: Russell B. Crawford, M.D. Heating Contractor: Gorman-Lavelle Plumbing & Heating Company. General Contractor: Cleveland Construction Company.

Hospital Heating . . . Weather-Controlled

Compact new six-story Euclid-Glenville Hospital utilizes unique design to hold down costs. Heating comfort with low fuel consumption is assured with "Controlled-by-the-Weather" Webster Moderator System.

The new 200-bed Euclid-Glenville Hospital, near Cleveland, Ohio, was built at a construction cost of less than $12,000 per bed. Compact design reduces traffic . . . speeds nursing service . . . cuts exterior wall space per square foot of floor area . . . eliminates long pipe runs.

The ten-zone Electronic Webster Moderator System of Steam Heating varies the steam flow automatically with changes in outdoor temperature. Zone Variators permit manual regulation of heat delivery for quick warm-up and reduced night heating. Webster Metering Orifices in each Webster Convector balance steam distribution to all radiators at the same time. Webster Radiator Valves provide individual *complete* shut-off at each radiator . . . Webster Traps keep radiators free of condensation at all times.

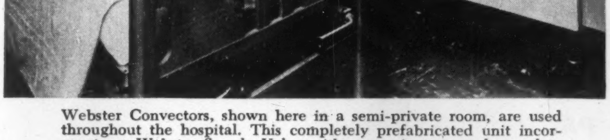
For more information, call the Webster Representative near you, or write us.

Address Dept. HP-11

WARREN WEBSTER & COMPANY

Camden 5, N. J., Representatives in Principal U. S. Cities

In Canada, Darling Brothers, Limited, Montreal



Webster Convectors, shown here in a semi-private room, are used throughout the hospital. This completely prefabricated unit incorporates a Webster Supply Valve with convenient manual complete shut-off, orifice, copper tube and aluminum fin heating surface, and genuine, long-life Webster Radiator Trap – all enclosed behind a substantial furniture steel cabinet.

WEBSTER

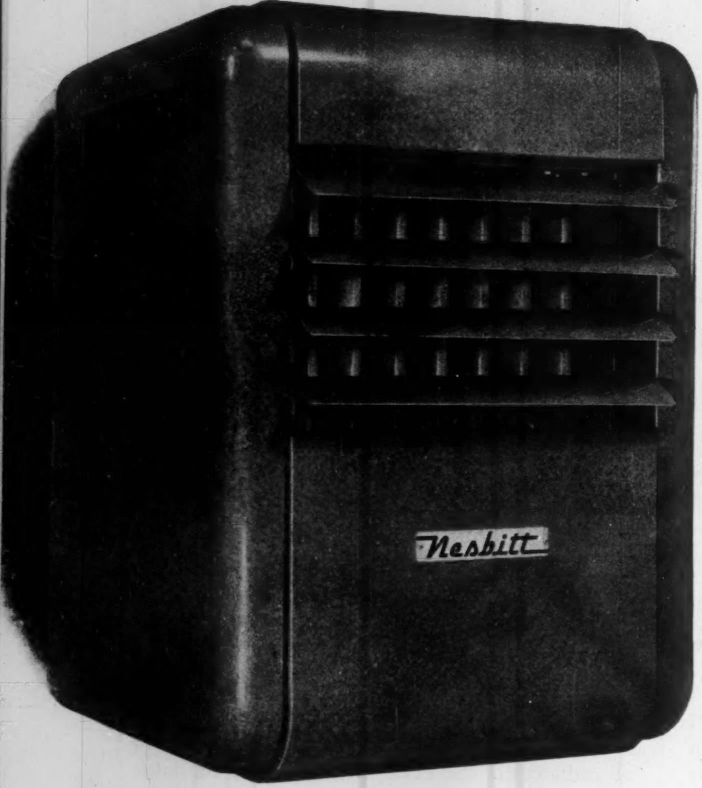
MODERATOR

SYSTEM

OF STEAM HEATING

"Controlled by the weather"

AND **Other Webster Heating Equipment for hospital use includes Tru-Perimeter Heating with Webster Walvector and Webster Baseboard Heating; Webster Control for Hot Water Heating; Webster Steam Heating Specialties for heating and process applications; Unit Heaters.**



Lights . . .

The industry spotlight is on Nesbitt Gas-Fired Unit Heaters

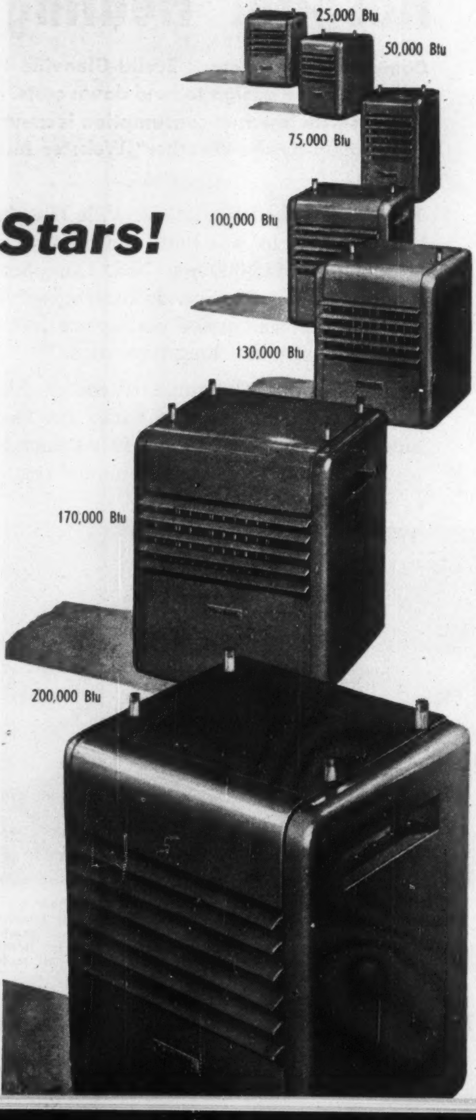
Camera . . .

Their beauty deserves your prolonged close-up view

Action!

And their role is to serve you better

The Family of Seven—All Stars!



HOLLYWOOD has never produced stars more illustrious than are these Nesbitt luminaries—of another field, to be sure, but one that is just as demanding of quality, art, and endurance.

THE PERFORMANCE of Nesbitt Gas-Fired Unit Heaters meets the informed critic's highest expectations of safe, clean, quiet, dependable, uniform, and economical heating, with all types of gases, at popular prices!

Seven basic sizes, from 25,000 to 200,000 Btu per hour input. Full details and application data, Publication 280.

NESBITT

GAS-FIRED UNIT HEATERS

Manufactured by
JOHN J. NESBITT, INC., PHILADELPHIA 36, PA.
Sold exclusively through wholesalers. Distributor inquiries invited.

Approved by A.G.A. and listed by Underwriters' Laboratories for use with natural, manufactured, mixed, and LP gases or LP gas-air mixtures.

"OPEN FOR DISCUSSION"

• WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

P. J. BOES —

"Preheaters Are Needed for Heavy Oil"

THE ARTICLE, *Use Light or Heavy Oil*, by Robert I. Anderson, in the April HPAC, was found to be highly interesting and useful. I would like to comment on it and ask if other HPAC readers would be willing to relate their experiences and comments on this subject, too.

In our experience, we have found that due to certain additional accessories required for the successful burning of the heavier grades of fuel oil, the amortization period extends to five or five and one half years.

We have learned that success in burning heavy oil depends, in a large measure, on the suppliers of fuel oil. Up to the middle of the war, we found that we were able to burn a No. 5, 300 sec SSU oil without preheating. Since that time, we have found it necessary to provide hot water heating coils in the storage tanks to assure delivery of oil to the burners in cold weather. In this case, the water is heated through a convertor. This added piece of equipment has increased the cost of heavy oil burner installations somewhat.

Also, we have learned that where a mechanical mixture of heavy bottoms and distillate is supplied, the lighter fractions tend to rise, leaving the heavier fractions in the bottom of the tank. Under these circumstances, it is inadvisable to shut down the burners for any extended period of time. In one case, we found that the operator was shutting down the heat to the tank coils over weekends, which of course caused some difficulties before the situation was corrected.

Many oil burner people recommend electric preheaters on all burners using No. 5 or heavier oil. The current consumption, of course, increases the price of oil at the nozzle. At this time, we are considering the use of electric pipe line heaters and electric heaters at the burners, making it possible to start up with anything that passes for No. 5 oil. We have always used electronic main flame and pilot supervision.

Summing up the accessories required to protect the owners against burner trouble, we find that the "paying off" period should be extended to five or five and one half years.—P. J. BOES, Registered Engineer.

T. MITCHELL —

"Refrigerant Piping Article Is Good"

WE FOUND the article, *How To Hook Up Refrigerant Piping*, by Lincoln R. Scafe, in the September HPAC to be a good one.

With a two-pipe equalizing system, compressors of different sizes can be installed if the oil line is at the level to be maintained in the crankcases. The machines must be set on the foundations at the proper height to keep the ends of this equalizing pipe horizontal. Of course, the gas line is installed above the equalizing pipe.—T. MITCHELL, Frick Co.

C. A. MILLS —

"I Found Article on Arctic Heating Helpful"

I HAVE FOUND the article, *Heating Arctic Building*, in the October 1953 HPAC, by Gordon R. Whitnah and Millard H. La Joy, very helpful, and I believe that other HPAC readers may be interested in some thoughts that came to mind when I read the article.

Since the very steep temperature gradients in structure walls set up by the severely cold Alaskan winters greatly intensify the kinetic heat flow problem for conventional heating practices, it seems desirable to emphasize here the structural and operative advantages of reflective radiant heating studies as developed through recent years as a result of my studies.

Decorative foil wall papers with 90 ± percent reflectivity for infrared rays, aluminized satin (Milium) as window drape material, foil and waffle-design rug underlays on floors where carpeting can be used have been developed and are available. These provide a reflective heat encasement on the room's interior facing and provide a great degree of freedom from cold wall effects and the problems of kinetic heat flow along the steep temperature gradients that generally prevail.

With such heat reflective room surfacing, radiant heat input is most effective when introduced from all or part of the ceiling where it can "see" the entire floor living area. Air warming then takes place in contact with radiantly warmed carpets and furniture surfaces, resulting in minimum vertical temperature gradients within the room. Since such heat reflective room surfacing materials are now available and in commercial use, it seems appropriate that attention be drawn here to the contribution they could make toward the simplification of Arctic heating and reduction in the heating loads.—C. A. MILLS, Professor of Experimental Medicine, University of Cincinnati.

C. J. KERN —

"Unit Heater Article Is Able Dissertation"

THIS IS IN REFERENCE to the article, *What You Should Know About Venting Unit Heaters*, by Henry H. Aronson, in the October HPAC. The article is an able dissertation on how to get the best results from air venting valves, but I would like to offer a few comments which I believe are pertinent.

Since the entire article is con-

Nautilus' Piping To Be Replaced

THE ATOMIC ENERGY COMMISSION has announced that the same kind of defective piping that ruptured in the USS Nautilus is being removed from the steam portion of the second land-based prototype submarine nuclear power plant which is being built at West Milton, N. Y. The piping for the Nautilus is now being replaced.

The West Milton piping replacement will not put the project — known as the SIR Mark A — seriously behind schedule.

cerned with the application of air valves to unit heaters in one pipe low pressure steam heating systems only, it appears that Mr. Aronson's objective in the article is to convince the readers that unit heaters will function properly on one pipe steam systems. Undoubtedly, one of his reasons for this is probably due to the fact that many engineers and specifying authorities have experienced difficulties with unit heaters on one pipe steam systems when the piping and provisions for venting have not been correct. Hence, two-pipe steam systems are specified in many cases where unit heaters are to be used in order to avoid the complications that might develop with one pipe steam systems that are not designed and installed correctly.

Of course, there is no need for venting valves on unit heaters in two-pipe steam systems, as all the air and water are removed quickly and completely through a combination float and thermostatic trap.

It has been our experience that most of the difficulties that have been encountered with air venting valves may be attributed to the fact that the parts are so small that they become corroded or clogged with dirt during the summer shut down period. Because these valves are small and inexpensive, the stems are usually not subject to regular maintenance procedures, so when the heating season begins again, operating problems are encountered. By contrast, the combination float and thermostatic trap used in two pipe installations have relatively large ports which as a rule do not become clogged. — C. J. KERN, Manager, Application Engineering and Service Dept., Warren Webster & Co.

G. J. MARTIN —

"Hope More Is Coming on Piping Maintenance"

I HAVE thoroughly enjoyed the article, *Piping Maintenance Practices Surveyed*, by Robert J. Pinske, in the April HPAC. I feel that there is a great deal of need in industry for planned preventive maintenance on piping systems. However, this article does not cover this subject fully, as it does not indicate the methods for making surveys, the type of forms to be used for periodic checking, and the steps to be used in the follow up to overcome irregularities.

I would like to see another article by Mr. Pinske in which these additional points could be discussed. I am sure that such an article would be very worthwhile and of interest to all engineers. — G. J. MARTIN, Manager, Mechanical Division, Production Department, National Biscuit Co.

EDITOR'S NOTE —

Refrigerant Piping for Parallel Compressors

IT IS REGRETTED that the illustrations for Figs. 2 and 4 were transposed when the article, *Better Refrigerant Piping for Parallel Compressor Systems*, by Lincoln R. Scafe, was published in the October 1954 HPAC.

Air Conditioning Booms in Fort Worth

. . . installed tonnage triples since '47

IN THE EYES of industry leaders in the state, the boom in Texas air conditioning offers frontiers still largely undeveloped. A new barometer for the weather making business in the Lone Star State is the $30 million dollar — in 1953 — air conditioning equipment manufacturing industry in Fort Worth. This figure is expected to triple in the next year. Backed by the vigorous Fort Worth Air Conditioning Association, the city is out to become "the cooling capital" of the nation.

In Fort Worth itself, already one of the nation's most thoroughly air conditioned cities — 279,000 population; 61,934 tons as of early this year — the demand is still growing, especially the market for central air conditioning systems. Of the total 1953 installations of 9854 tons, 700.5 tons went into 18 separate church installations. Most major office buildings are air conditioned, and new offices opening in converted residences or small office buildings are rapidly being air conditioned.

Since 1947 Fort Worth hospitals have accounted for 16 air conditioning installations. Other installations which have been made or are rapidly being made are in stores, restaurants, clinics and doctors' offices, hotels, tourist courts, banks, educational buildings, transportation terminals, theaters, and industrial, military and miscellaneous properties.

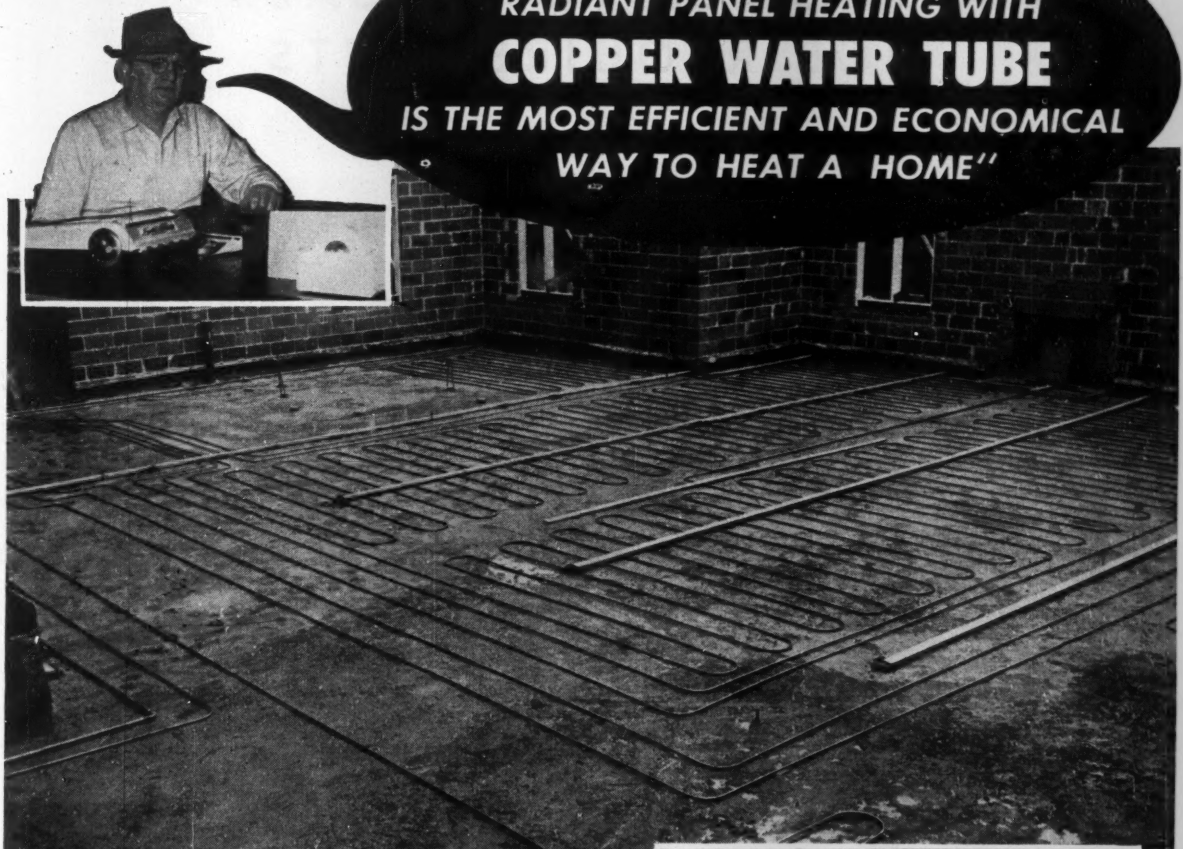
The total tonnages installed are given in the accompanying table for each year from 1947 to 1953.

GROWTH OF Central Type Air Conditioning in Fort Worth

Year	No. of Installations	Tons
Up to 1947.	277	20,627
1948	269	4,985
1949	251	4,491
1950	346	5,531
1951	407	8,440
1952	495	8,006
1953	631	9,854
TOTALS	2676	61,834

Says **William H. Bodendorf**, Pres.
WILLIAM H. BODENDORF & SONS
Westfield, Mass.

"IN MY EXPERIENCE RADIANT PANEL HEATING WITH COPPER WATER TUBE IS THE MOST EFFICIENT AND ECONOMICAL WAY TO HEAT A HOME"



Mr. Bodendorf has been in the heating business for 30 years and in the radiant heat field for 9 years. He prefers radiant panel heating, using copper water tube, to all others. Here's why:

> *"Heat is distributed more evenly . . . there are no hot and cold zones, no drafts, so radiant panel heating is healthier. Also, it permits greater latitude in room arrangement, and more usable space. There is less cleaning and decorating to do than with conventional heating systems, while operating costs are invariably less.*
>
> *"From my standpoint as a contractor I prefer Revere Copper Water Tube because it is easy to bend and handle . . . its long 60′ lengths require fewer fittings and the solder fittings used eliminate the need for welding, wrench work and thread cutting. And most important; Revere Copper cannot rust so it keeps me out of trouble, helps build my reputation for quality work."*

That Mr. Bodendorf has a reputation for quality work is attested to by the fact that of the more than 550 radiant panel installations he has made, he has never received a single complaint.

You, too, can keep out of trouble with Revere Copper Water Tube. Use it for radiant panel heating, hot and cold water lines, underground service lines, air conditioning and processing lines, waste stack and vent lines. There is a Revere Distributor near you who carries a full supply of Revere Copper Water Tube in various sizes and tempers. And if you have technical problems, he will put you in touch with Revere's Technical Advisory Service.

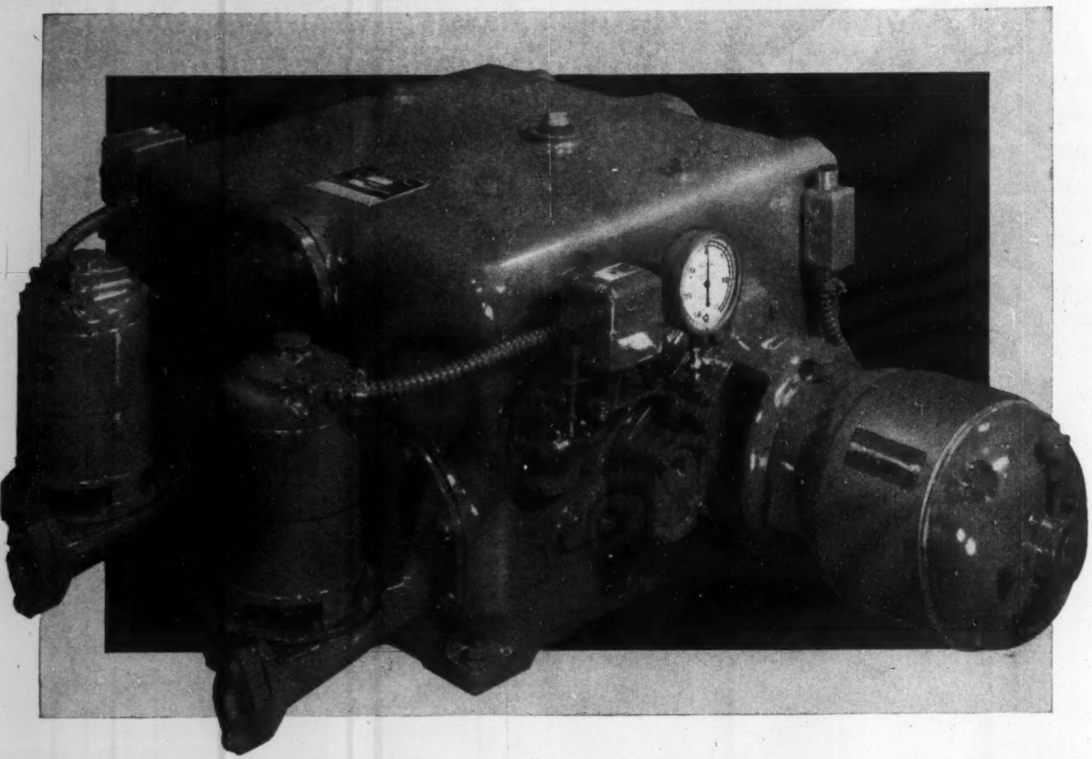
ONE BIG FEATURE of Revere Copper Water Tube is that Radiant Panel Heating coils are readily prefabricated in the shop. Time is saved, working conditions are more ideal, installation costs are cut. BODENDORF & SONS get their Copper Water Tube needs through the Revere Distributor, WARNER SUPPLY COMPANY, Westfield, Mass.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



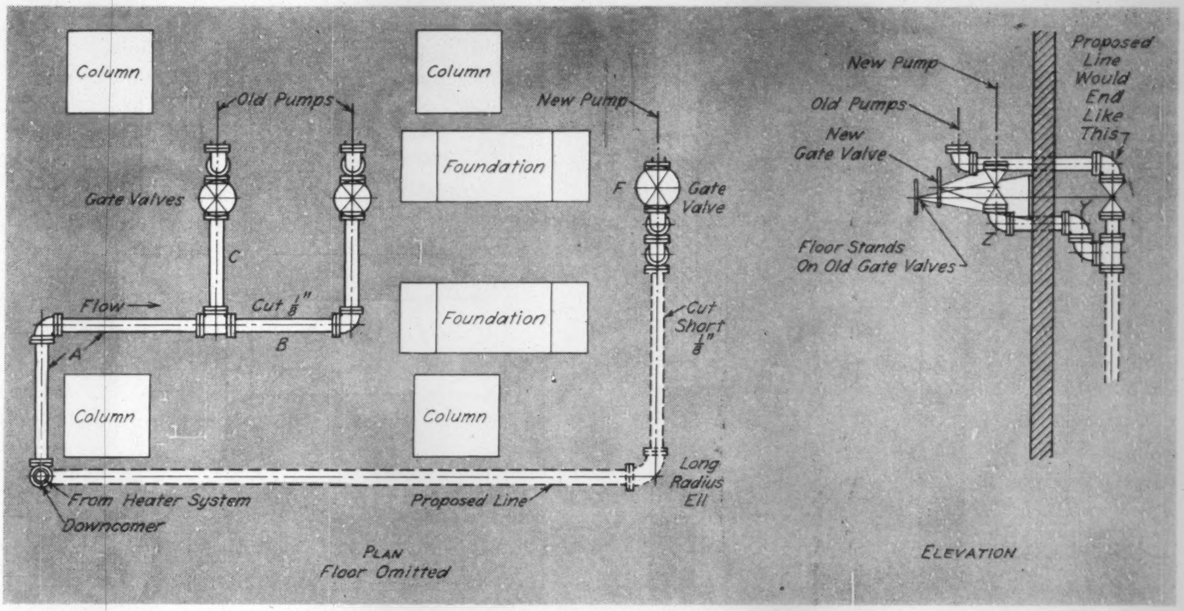
It's the Nash CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- ✓ **Increased air capacity induces rapid system response without wasteful overheating.**
- ✓ **Separate air and water pumps individually selected to meet actual job requirements.**
- ✓ **Control system that operates individual pumps only when needed.**
- ✓ **Flexibility permitting addition of radiation without changing basic pump installation.**
- ✓ **Low, low, return line connection.**

NASH ENGINEERING COMPANY
438 WILSON, SO. NORWALK, CONN.


Column
Column
Old Pumps
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Cut 1/8"
A
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Column
Long Radius Ell
From Heater System Downcomer
Proposed Line
PLAN
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New Pump
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Proposed Line Would End Like This
Y
Z
Floor Stands On Old Gate Valves
ELEVATION

"WE'LL have to put a new fitting on the heater and drop a new and larger line down to the new pump, or make that downcomer large enough to take care of all three pumps. The main thing is to get rid of the friction and increase the Net Positive Suction Head."

Pump Made to Operate Right

. . . piping change improves Net Positive Suction Head

By Bill Dopp

PRACTICAL PIPING PROBLEMS

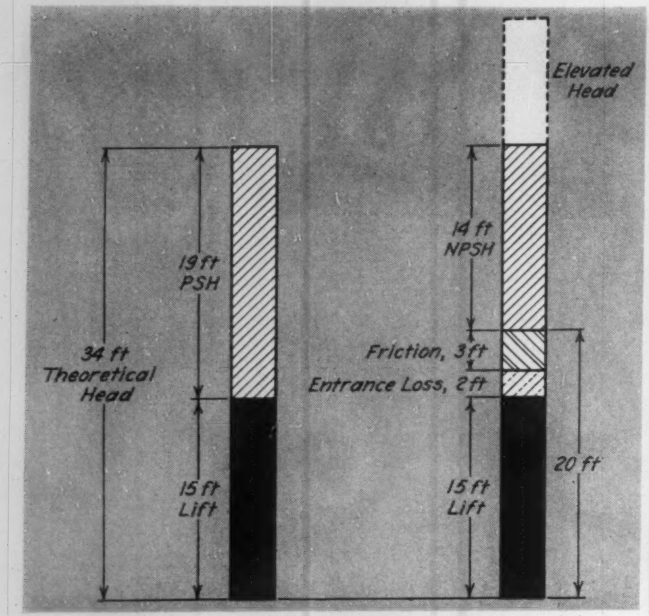
• Bill Dopp has had some 40 years of experience dealing with piping, including a long stretch of service as a sales engineer. He is devoting part of his present leisure to drawing on his many piping experiences.

This month, Mr. Dopp's principal character, Martin MacVane, takes it on the chin for a hasty and inadequate solution he has proposed to correct the whistling and vibrating of a new pump installed in an existing system. You will enjoy discovering how the faulty piping layout is corrected for Mac's friend, Harvey Davidson, chief engineer of the plant.

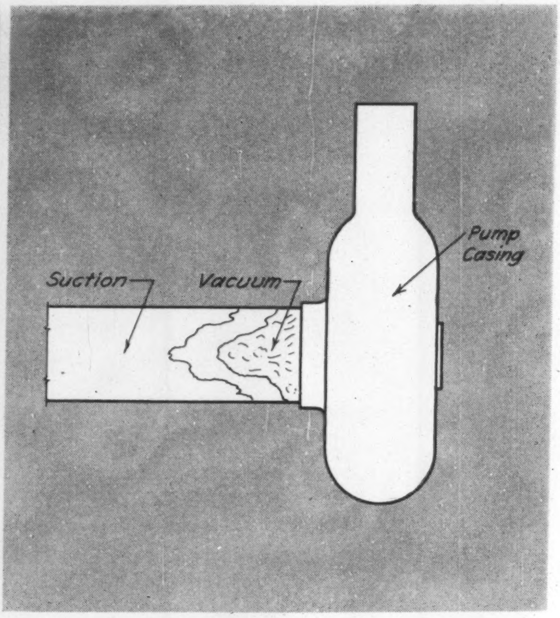
"COME RIGHT IN, Mac," greeted Harvey Davidson, chief engineer of the municipal power plant, as Martin MacVane approached the group assembled around the new centrifugal pump. Mac had dubbed it "The Musical Pump" on a previous visit because of the howling noise it was making. He had given Harvey some suggestions as to how the trouble might be corrected.

"You sent for me, Harvey?" inquired Mac.

"You bet I did," acknowledged Harvey cheerfully. "Meet Paul Scholl, pump specialist. Paul, this is Martin MacVane, ex-engineer, gasket salesman and good friend, all in one." Harvey had a broad grin. "You two should have a good time together," he added, turning to Mac. "Paul



"IT'S THE DIFFERENCE of nineteen feet — the margin between the practical limit and the theoretical limit — that draws the water into the pump . . . That's the positive suction head"



"THE GREATEST source of trouble in a boiler feed pump is lack of suction head. Every boiler pump is based on a specific minimum total suction head above vapor pressure, otherwise the pump will quickly reach the break-off point and cease to function."

doesn't agree with you at all."

"Not so fast," interjected Paul. "I did not say that, Mac — I can call you Mac, can't I?" Mac grinned his agreement. "What I did say was that there are probably other elements in the problem of this pump than those that you have exposed."

"That could very well be," declared Mac cheerfully. "I gave Harvey the benefit of a casual observation of the situation and pointed out some of the perfectly obvious causes of trouble." He poked a finger at Harvey. "Paul, or anyone else, will have to agree that the combination of piping strains that you have on that pump, plus the excessive turbulence that you are putting into it, are responsible for at least a large part of the noise the pump was making."

Net Positive Suction Head

"You're dead right there," agreed Paul. "However, I contend that there is another factor that has probably been overlooked. This is the Net Positive Suction Head."

"Oh! Oh!" exclaimed Mac. "That can be a big factor here. I'll admit that I was so concerned about the piping strain that I never gave the NPSH a thought. Have you checked it?"

"Not yet," replied Paul. "Let's get Harvey straight on this piping strain and that whirlwind turbulence before we try to go into that. Just what did you tell our greatly distressed friend?"

"Suppose we go back to the office first, where we can have a little quiet and the drawing before us," said Mac. They followed him as he moved in the direction of the stair.

When they got settled in the office, Harvey turned to Mac. "Looks like your lead," he said. "Paul wants to know your side of this argument."

Piping Strains, Turbulence

"Listen, Harvey," exclaimed Paul. "There is no argument here. As I get it, Mac told you piping strains and turbulence were responsible for your trouble. That's true. All that I want to do is to find all the factors that might cause the pump to fail." He shifted to a more comfortable position. "Harvey, the weight of piping and expansion strains can easily ruin a pump. It's just like a turbine; these forces must be kept to a minimum. What's more, you must take into account the changes that take place under different operating conditions. . . . Don't forget, contraction exerts just as much force as expansion, only in the opposite direction."

"I've seen the power of contraction pull piping apart more than once," remarked Mac. "On one occasion, it shut all of the natural gas off for a large city in below zero weather. It was anything but funny."

Resistance to Flow Important

"There seems to be a general impression that a pump will operate against a fixed capacity regardless of the pressure drop in the piping system," declared Paul. "That is not true." He pointed to the print on the desk. "The piping resistance has a profound influence on both sides of the pump. Turns, branches and valves set up far greater resistance to flow than people generally realize."

"As I told Harvey," interrupted Mac, "you can't just add the resistance of one ell to another if they are close together, because the turbulence created by the first ell actually increases the amount of resistance that will be developed by the second ell. Each one you add to the chain multiplies the effect. So the only way to get at the actual resistance of a row of turns is to measure it."

"That's correct," agreed Paul.

"In this type of pump, the impeller is literally pulled into the suction water pathway. The thrust load on the bearings is always acting in the direction of the suction end of the pump. Now, if you introduce excessive turbulence into the suction eye, you can easily change the direction of that thrust. In fact, you can get it to oscillating back and forth so that even with the close clearances that are maintained, your pump can sound like a trip hammer."

"What Do Piping Strains Do?"

Mac started to laugh. Paul looked at him questioningly. "Just what I told Harvey," Mac said. "Now what about the piping strains? What do they do?"

"That can be even worse," declared Paul. "For instance, the semi-open type of impeller depends upon close running clearance of ten thousandths of an inch of the finished surface of the suction cover. Put a pipe strain on that cover and you quickly kill that clearance on one side or the other, causing excessive friction on both the suction eye and on the bearing. The water is supposed to act as a lubricant, but if it can't get into that closed space, the parts begin to heat, causing more friction. That is probably your squeal, Harvey. It can stop your pump."

Harvey had been silently taking in the discussion. His face was grave as he said slowly, "I suppose I'm like a lot of other people who have never realized how really delicate a piece of machinery a centrifugal pump has become. You look at it and think it a rugged piece of equipment — so solid that it could take a lot of abuse. Actually, it's a delicate mechanism." He rubbed his chin. "But Paul, you said there were other things causing the trouble —what are they?"

"Just the little matter of NPSH or Net Positive Suction Head," affirmed Mac. "It's going to be interesting to see how Paul is going to explain that." He leaned back, grinning.

Two Kinds of Suction

Paul eyed him suspiciously. Harvey's expectant expression was comical. "I'll make a try," he said. "In the first place, we must keep in mind that there are two kinds of suction conditions which create entirely different situations in the pump. However, these are so closely related that the change from one condition to the other can take place while the pump is running. The first condition is that of suction lift. The other is a condition of suction head.

"A boiler feed pump normally operates with suction head," he continued thoughtfully, organizing his story. "Let's get rid of a couple of fundamentals first." He picked up a pencil, using it like a wand. "Air that finds its way into the pump casing proper, or into the suction line, makes this type of pump useless. This is true also of hot water that has flashed into steam inside the casing or in the suction eye of the impeller. Air pockets in the suction piping due to down sloping of the suction line will cause loss of suction and may permit air to be drawn into the pump, doing serious damage."

"Here we go back to the piping," asserted Harvey. "Looks like everything depends on that."

"I've always insisted that piping is the most important factor in successful plant operation," contended Mac, grinning at Paul. "It's true in spite of the importance that Paul places on his pumps. Poor piping design can knock him out."

"You're right there, Mac," agreed Paul. "But let me finish my thought about air. The outstanding problem in operating under suction lift is to keep the pump primed. Casings must be vented of entrapped air before starting the pump; so, permanent vents and proper valves should be installed on the vent openings." He looked thoughtfully at Mac. "Working with cold water, and a suction lift, if you eliminate all air, all piping strain, keep the turbulence at a minimum and see that the outboard bearings are greased, your pump will run perfectly for a long time. But don't try to run rocks through it," he chuckled.

"Nice going, so far," affirmed Mac cheerfully.

Pumping Hot Water's Different

"When you begin to pump hot water, the whole situation changes. The faster the pump throws water up the discharge, the more it reduces the pressure in the suction pipe at the inlet of the pump. This drop in pressure can become so low that a strong vacuum is created. Here is where real trouble occurs. A part of the water flashes into steam and the pump quickly runs dry. We call it steam or vapor binding. It can seriously damage a pump in a few minutes." Paul thoughtfully ran his hand through his bushy hair.

"When you get to the creation of a vacuum at the inlet," suggested Mac, "you have reached the break-off point. No more water enters the pump."

"That's right, Mac, but before you actually reach the break-off point, when the pressure is reduced almost to flashing, bubbles will form on the under side of the impeller vanes near the base. These travel rapidly along the under side of the vane until they collapse. They are really little vacuum pockets sometimes called cavitations. These break so fast that water hits the vane like the blow of a hammer, hard enough to break off tiny pieces of the impeller."

"Is that what causes pitting?" ventured Harvey. "I had to replace the impeller on the number two pump a while ago. It looked as if rats had chewed it."

"That is a large part of the cause, but the chemical action of the fluid has a lot to do with it, too," asserted Paul. "There are ———"

"Pardon my interrupting, Paul," said Mac, holding up a restraining hand. "Let's not get into that erosion-corrosion hassle right now. The NPSH is the primary subject here."

The Positive Suction Head

"You're right," replied Paul, "I'll stick to that. The theoretical limit to which water can be lifted by a perfect vacuum is thirty-four feet. This is practically impossible. A practical limit of fifteen feet as the suction lift of a centrifugal pump is commonly used as a base for figuring efficiency of operation. This lift will raise the water to the centerline of the pump but will not feed the water into the pump. It's the difference of nineteen feet, the margin between the practical limit and the theoretical limit, that draws the water into the pump. That's the positive suction head."

"You're getting along all right, Paul," encouraged Mac. "Now what is Net Positive Suction Head, and what if anything does friction have to do with it?"

"The Net Positive Suction Head," declared Paul, "is the pressure at the suction of the pump over and above the pressure needed to keep the fluid being pumped from vaporizing at the temperature at which it arrives at the pump."

"Does that apply only to hot fluids?" asked Harvey.

"No," answered Paul." Cavitation can occur with ice cold water if the pressure is sufficiently reduced by friction loss."

"Where does the friction come in?" demanded Harvey.

"There are certain friction losses that occur just inside the suction flange of the pump and in the eye of the impeller," replied Paul. "These losses in pressure are dependent on the kind of fluid being pumped, on its temperature, its velocity and in part on the design of the pump. The Net Positive Suction Head must not be used up by these friction losses. There are certain recommended minimum pressures below which it is not safe to go, as indicated in the Standards of the Hydraulic Institute. A pump does not have to be vapor bound to be in trouble. A cavitating pump is not only inefficient but will soon need repair."

"There's another kind of friction, isn't there Paul?" asked Mac.

"Yes," asserted Paul. "Whenever you move a fluid through a tube there is friction with the walls of the tube and other things such as bends and valves. This friction will depend upon the age and condition of the piping and varies considerably. The piping layout has a lot to do with it, too."

"What About NPSH?"

"We still have not gotten to the NPSH," declared Harvey.

"Oh, yes, we have," declared Paul. "Thirty-four feet less fifteen feet suction lift, two feet entrance loss and three feet pipe friction loss makes a total of twenty feet and leaves fourteen feet Net Positive Suction Head."

"If it's as simple as that why all the fuss about it?" demanded Harvey.

"Because it is so often neglected," supplied Mac. "Let Paul go on."

"Probably the greatest source of trouble in a boiler feed pump is lack of suction head. Every boiler feed pump is based on a specific minimum total suction head above vapor pressure; otherwise, the pump will quickly reach the break-off point and cease to function. It might be hopelessly damaged. Then, too, the suction head must be adequate to protect the pump in case of sudden changes in the feedwater temperature." Paul reflected a moment. "At two hundred and twelve degrees a rise of 1 percent or two degrees will decrease the suction head about two feet. At three hundred degrees a rise of 1 percent or three degrees will reduce the suction head seventeen feet. A fluid at a higher temperature requires higher NPSH than it does at a lower temperature. So, the suction water source of the boiler feed pump has to be elevated to give the needed additional head to keep the total suction head above the vapor point."

Paul stopped abruptly. Mac caught his appealing glance. Picking up the story, he said, "Harvey, the pump designers take care of all the factors within the pump and try to out-guess the piping designers. The latter can easily wreck all of their careful work by failing to recognize that the piping friction may so reduce the NPSH as to make the pump inoperative." He reached over to spread out the blueprint. "In an installation where there is a fairly long suction line, such as you have here, calculations will depend upon what data is used. Much has been published on this subject of friction in piping, valves and fittings, but this data does not agree, since age and condition of the piping have a lot to do with the figures given. Every pump manufacturer has his own favorite source of data. Isn't that so, Paul?"

"Right! The *C* factor or coefficient of the pipe condition is always a disputed point, so they apply a correction factor which is also open to argument. The thing is, everybody stays on the safe side. Your layout here looks to me to be a troublemaker."

"I think I get your point, Paul," declared Mac. "Suppose you support that idea." He could see that the pump salesman was tiring, but the matter had to be cleared up, or Harvey would be left out on a limb.

Cavitation May Be the Result

"Look," began Paul, pointing to the drawing, "these two pumps were working all right before Harvey began monkeying with the layout. The new pump wouldn't work. Mac diagnosed a part of the trouble, but that rattle when you opened the delivery valve wide spells cavitation, or I don't know pumps. That means just one thing, insufficient NPSH. The net has been reduced too far by piping friction."

"I still don't see where," declared Harvey. "What makes the difference?"

"When you cut into the suction of the second pump, you lengthened the line and introduced a couple of other factors — a tee and several ells. That suction pipe to number two pump is just about large enough to keep that pump out of trouble. The load to the new pump would put number two out of commission, if you had tried to run these two at the same time. To make matters worse, the new pump has a higher capacity than either of the old pumps."

"Then Mac's idea of a remedy would not have worked either," accused Harvey, looking sharply at the gasket salesman.

New Suction Line Needed

"I'm guilty," admitted Mac. "It just shows the folly of trying to design piping on the spur of the moment. We should have started from scratch on this thing." He glanced inquiringly at Paul. "I take it that you think a new suction line from the heater to the new pump is the answer here?" he asked.

"Yes, Mac," agreed Paul, "We'll have to put a new fitting on the heater and drop a new and larger line down to this pump. Or we might make that downcomer to the basement large enough to take care of all three pumps. Then we could follow along the line of your suggestion around the further pillar to get plenty of expansion leeway. The main thing is to get rid of the friction and increase the Net Positive Suction Head."

"I'm sorry, Harvey," said Paul turning to the engineer. "I'll have to get home for a rest. I've been ill, and I'm not quite up to a full day yet." He got up a little unsteadily. "I'll get around again tomorrow, and we'll figure this thing out completely so there won't be any more trouble."

"I'll drive you home, Paul," offered Mac.

"Thanks. I'm sorry to have disputed your suggestions, Mac, but you can see how it is," he said apologetically.

"Forget it, Paul. I'm glad that you got into the picture before Harvey had changed his line. Seems I was right as far as I went. Didn't go quite far enough, though."

"Sorry, old top," he said to Harvey as they shook hands. "I'll get this fellow home. He'll be able to get you squared away tomorrow. Good Luck."

New Rating Code for Steel Boilers Published

. . . Boilers redesignated

THE PUBLICATION of the sixth edition of the Rating Code for Steel Boilers is announced by the Steel Boiler Institute, Inc.

Many changes from the previous edition, issued in January 1948, have been incorporated in the new edition. Among these changes are the extension of sizes of the former residential series from 3000 to 5000 ft SBI net (steam) rating and an increase of 12½ percent in the water rating of mechanically fired boilers. These boilers, which were formerly termed "residential," have now been designated as "Table 2 Boilers" due to the fact that the addition of the larger sizes makes this series applicable to other than residential use.

The former "Commercial" series is now designated as "Table 1 Boilers" and three larger sizes have been added.

Copies of the SBI Rating Code for Steel Boilers may be obtained from the Steel Boiler Institute, Inc., 1308 Land Title Bldg., Broad and Chestnut St., Philadelphia 10. Price, $1.00.

Air Conditioning Profits Up, Sales Down

. . . for first 10 months

NET PROFITS of the Carrier Corp. for the first 10 months of fiscal 1954 were 15 percent greater than for the same period 1953, reports Cloud Wampler, president.

The completed sales totaled $125,628,000 as compared with $133,747,000 in the same period last year. The net decrease resulted from a decline of $21,303,000 in government business, which was not entirely offset by an increase of $13,184,000 in civilian sales. Total civilian business for the period was $90,813,000, the gain being almost 17 percent.

"Completed sales for fiscal 1954 as a whole cannot be accurately estimated at this time," Mr. Wampler said, "but I believe they will be 10 to 15 percent less than last year."

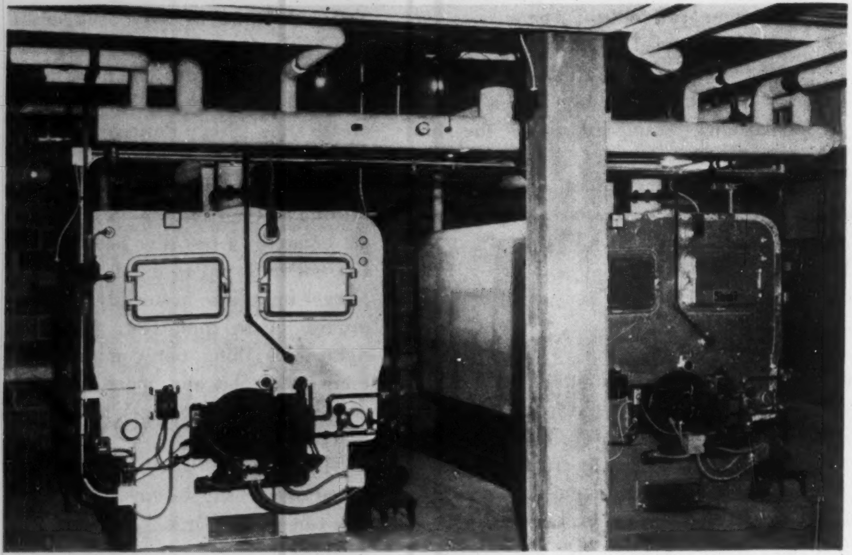
Specifications Standardize Filler Metal for Welding

. . . in 22 classifications

FOR THE FIRST TIME filler metal for inert gas, metal arc welding has been standardized by new specifications issued jointly by the American Society for Testing Materials and the American Welding Society.

These specifications include aluminum and aluminum alloy welding rods and bare electrodes. The rods are for use with gas, carbon arc, atomic hydrogen and inert gas, metal arc — non-consumable electrode — welding processes. The bare electrodes are used with the inert gas, metal arc — consumable electrode — welding process.

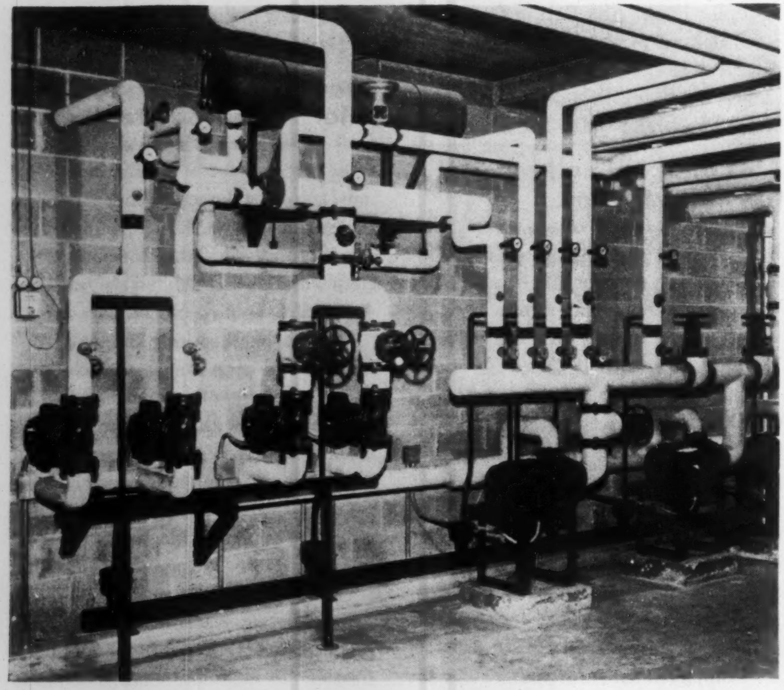
Twenty-two classifications of filler metal are established by these specifications, including all common aluminum and aluminum alloy filler metal.



HEART OF THE SCHOOL'S forced hot water heating system are these cast iron sectional boilers. One is a standby while the other carries the load

Hot Water Heats

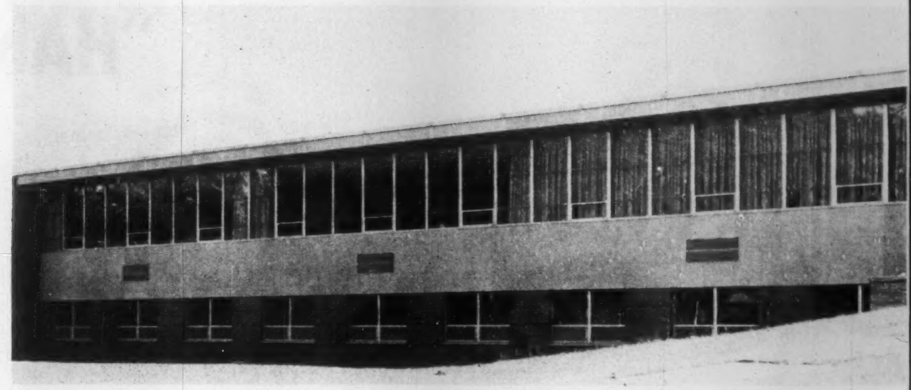
Convectors, finned tube radiation, and a central fan system are all



HOT WATER CIRCULATING pumps, kindergarten floor panel converter and expansion tank with piping, valves and thermometers are shown above

THE NEW Eastport school in Michigan City, Ind., is heated by a combination of methods utilizing forced hot water. The two-level, L shaped building contains 15 classrooms, a kindergarten, auditorium and gymnasium, principal's offices and other smaller rooms normally found in a large school building. The offices and smaller rooms are heated by finned tube radiation and convectors, manually controlled, and all other rooms are controlled pneumatically. The lower level rooms at the front of the building and the kindergarten are equipped with unit ventilators suspended from the ceiling. All other classrooms have floor standing unit ventilators.

Two cast iron sectional boilers, each with an IBR net rating of 1,939,000 Btu per hr, are at the lower level junction of the two building wings. One boiler carries the building



VIEW OF THE EAST WING of the school, showing louvers for unit ventilators suspended from the ceiling and those on the floor

New School 5 Ways

unit ventilators, a floor panel, combined in this unusual installation

By Winston R. Kelley
Vice President
Eddy Isbey, Inc.
Contractors & Engineers

load, and the other is a standby. These boilers are fired with cold No. 5 oil using rotary cup burners. Each boiler has an induced draft fan which operates in conjunction with the oil burner controls. Above the boilers are three compression tanks each with a capacity of 80 gal and equipped with sight glasses.

How System Operates

Each building wing or zone has its water returned by a close-coupled centrifugal pump, with one duplicate standby pump for either zone. The kindergarten floor panel and the auditorium ventilation coil use in-line pumps, each with a duplicate standby. Each return line has its own dial type thermometer and balancing cock.

All classroom unit ventilators contain a three-way mixing valve serving the heating element, and a modulating valve serving the window radiation. This valving system assures closer control of water temperatures and thereby minimizes temperature over-runs. The water supplying the three-way mixing valve has its temperature varied by an outdoor-indoor control operating in conjunction with the oil burner. Lower temperature water required for the kindergarten floor panel is obtained by means of a water-to-water heat exchanger. The floor panel water temperature is controlled by a capillarystat, bulb and valve.

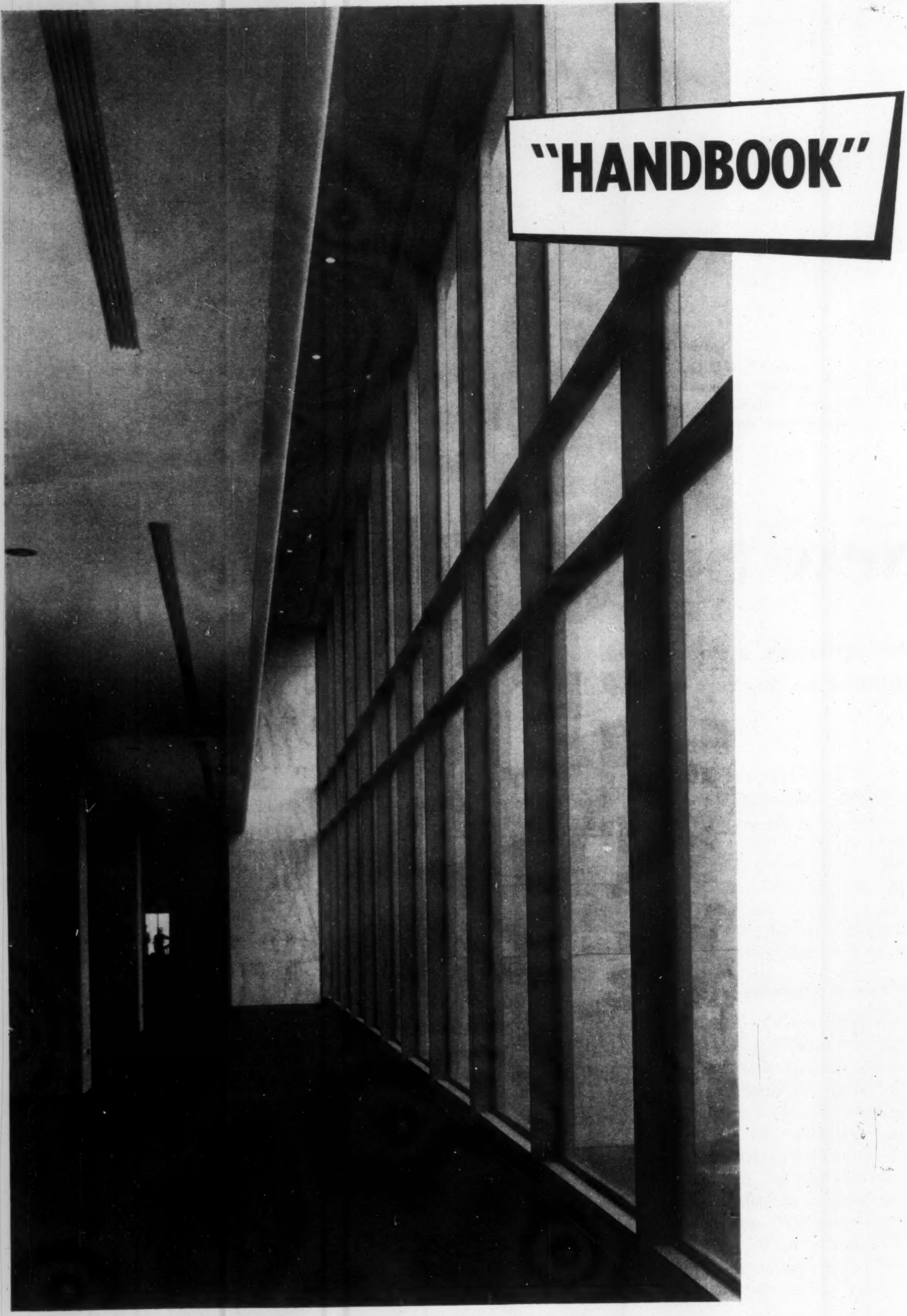
The auditorium is heated and ventilated by a central fan system in the boiler room and continuous two-row finned radiation beneath the windows The auditorium coil receives its water through a three-way mixing valve similar to that for the classroom unit ventilators. The auditorium finned tube radiation is also controlled pneumatically. The central fan system contains four pneumatically controlled dampers to facilitate the mixing of various proportions of indoor and outdoor air as required.

All pipe is wrought iron, and sizes ½ in. and larger are joined by welding.

During installation of this system, piping problems were at a minimum, since rises, drops, pitch and pipe expansion did not have to be dealt with.

From the standpoint of maintenance, a forced hot water system such as this one has several advantages. There are air vents, but once the initial air is eliminated from the system, very little more will accumulate. The vents are easily reached or replaced, and the replacement cost is small. The circulating pumps also are readily accessible and conveniently maintained.

The system was designed by Boyd E. Phelps, Inc.

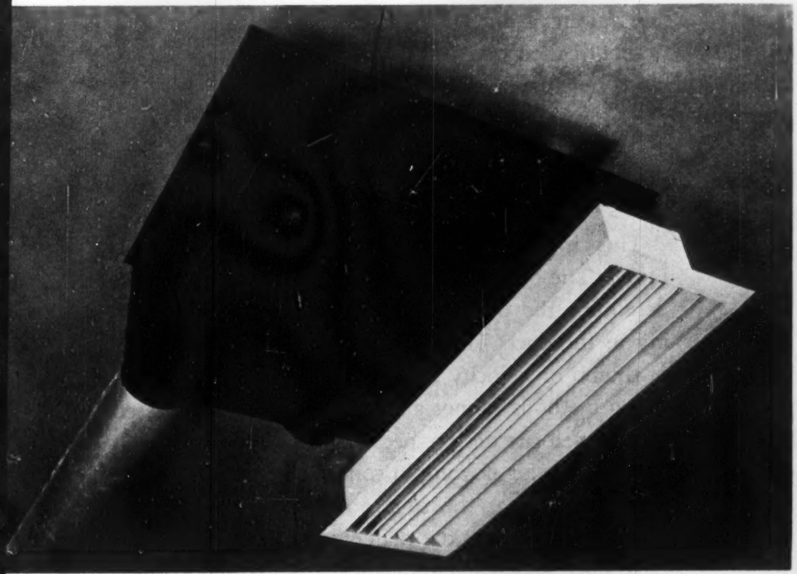

"HANDBOOK"

on High Velocity Air Distribution Design

• There is no doubt that high velocity air distribution systems for air conditioning are gaining rapidly in acceptance. But because of the lack of interchange of design information, many engineers are learning about these methods the "hard way."

This article, prepared especially for heating and air conditioning engineers and contractors who design and install air conditioning systems, points to those sections of the distribution system which should receive particular attention in order to avoid unnecessary waste of fan horsepower. It points out also where substantial savings in sheet metal duct material can be made without affecting the fan horsepower.

By C. Milton Wilson
Anemostat Corp. of America



STANDARD straight line diffuser with combined high velocity unit. Actuator is made accessible by removing diffuser

AIR DISTRIBUTION systems of the type described here should be thought of as "high velocity" rather than "high pressure." The benefits of the system are entirely from high velocity. Therefore, it should be the engineer's constant objective to accomplish the economical design objective with the least pressure.

In adapting the design to a building, it is logical to use high velocity where space can be saved. Conversely, it is illogical to use high velocity in sections of the system where space is available to enlarge the ducts and reduce the pressure. This article explains simply how the interchange of velocity and static pressures can accomplish this objective. It also discusses how temperature differentials can be manipulated to reduce fan horsepower and save metal.

Heating and air conditioning engineers and contractors, recognizing the economic changes that have taken place in the building industry, are revising their techniques of design and concepts of systems. Coupled with the revised economic conditions, the new designs recognize changes in people's attitudes and reactions to air conditioning systems. The postwar public, which has become extremely conscious of both sounds and drafts, is continuing to boost the trend toward individual room control of air conditioning.

Ceiling architecture — the aesthetic and proper technical correlation of air diffusers, acoustical materials, lighting fixtures and color — has become an interesting combination problem facing architects, engineers and specialists. Operating engineers for building management companies, confronted with increasing operating and maintenance costs, demand installations which are easy to maintain, inexpensive to operate and as nearly complaint-free as engineering thinking can produce.

The advent of high velocity — and when applicable, high velocity-high temperature differential air distribution systems — is the most important change in the air conditioning industry that points to the solution of most of these problems.

I THE FUNDAMENTALS

A national survey reveals that engineers are studying, learning and using high velocity with increasing diligence. Unfortunately, the basic concept of this design is not always recognized, resulting at times in excessive fan horsepower and unnecessarily high first cost. A discussion of the fundamentals of high velocity design should clarify the basic concept. Therefore, both original and collected ideas are presented here, all of which have been modified by observation of extensive and challenging research programs.

Pressure-Velocity Relations

To properly analyze the true concept of high velocity air distribution, it is important to refresh one's memory regarding the fluid flow relation of total pressure, velocity pressure, static pressure and friction pressure loss. There is no finite relation between static pressure and velocity. For example, it is possible to have high pressure and no velocity. That is, there can be 100 lb pressure in a pipe with no velocity or flow. Also, there can be high velocity with no static pressure, like the physical condition of a free-flowing jet. The relation of the four pressures along a duct is, of course, established by the Bernoulli theorem.

$$P = P_s + P_v - P_f = P'_s + P'_v - P'_f$$

when P = Total pressure at start of duct
P_s = Static pressure
P_v = Velocity pressure
P_f = Friction loss plus dynamic loss.

This is illustrated by the elementary diagram, Fig. 1. The configuration of the duct and its friction determine the pressure-velocity relation of air flowing in the duct. This must be stressed because rule-of-thumb or velocity sizing or even straight friction sizing methods cannot and should not be considered in high velocity design, because we are working with high energy air flowing in conduits in which friction varies directly as the square of the velocity of the air and inversely as the diameter of the conduit.

A duct which expands in size and then reduces back to its original size is shown in Fig. 1. The top graph, for a theoretical duct without friction, shows that the total pressure remains constant and the static pressure increases as the velocity is decreased in the enlarged section of the duct.

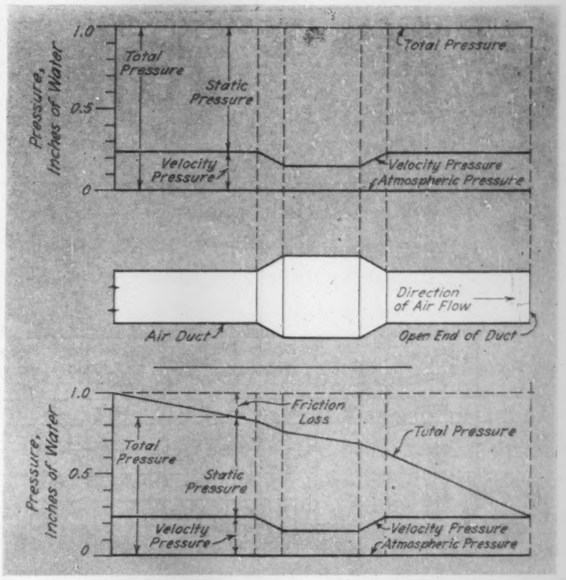
The lower graph shows an actual duct condition when friction enters the fluid flow relation. However, the total pressure drops and the static pressure is reduced by the friction plus dynamic pressure loss. The velocity pressure remains exactly the same, as it is not directly influenced by the friction.

How The Sound Problem Is Handled

These pressure-velocity relations can be used for a practical and easy-to-use method for designing high velocity air distribution systems. The technique varies from the design of low velocity systems, because the problem of sound is handled on an entirely different basis. In conventional systems the neck size of the diffuser, the branch duct, and a substantial portion of the main duct are sized by the velocity method, with the velocities selected according to the engineers' experience, or as recommended by experienced and reliable diffuser manufacturers.

Although neck velocity as related to the height of a diffuser above an occupied zone has been generally accepted as a design criterion for sound control, the method is crude and does not account for other important variables. For example, this method does not take into account the effect of the air mass. Quantity has a very important influence on the sound level. The approach to the diffuser and the accessories, equalizing deflectors and volume controls, can increase or reduce the sound level at diffusers, according to their design and application. The "balancing effect," or throttling effect, of dampers creates sound which, in most cases, creates a lot of noise, even though the neck velocity is selected at a low value to obtain a quiet air flow into a room.

In high velocity systems, the diffusers and their attenuating boxes are selected more scientifically to satisfy predetermined sound levels. The important influence of the mass flow, the effect of all the accessories, and static pressure reduction at the attenuator-diffuser combinations are selected from tables which account for the most important variables — namely the quantity and static pressure against which the diffuser must be balanced and the required sound level. Because the approach to the diffuser, the sound attenuator chamber, is factory made, complete with accessories, the effect of these variables is accounted for as the manufacturer calibrates the combination to establish his selection tables.



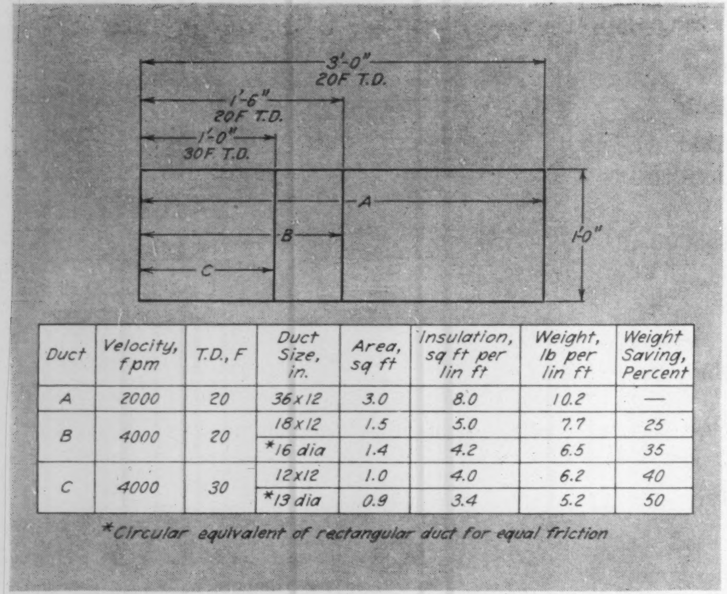
1 HIGH VELOCITY DESIGN must take into account pressure-velocity relations. These are determined by the configuration of the duct and its friction

What Are Basic Design Objectives?

The ducts in high velocity systems, within practical limits, can be sized in accordance with the fundamental mechanics of fluid flow and with no influence by, or regard for, sound. This method is directly opposite to low velocity duct sizing methods, where the "sound" variable in all, or at least part of, the system takes precedence over the scientific application of fluid flow mechanics.

The basic concept, or true engineering objective, is to obtain savings in building space, field labor and pounds of sheet metal without the penalty of an excessive fan horsepower and consequent high operating cost.

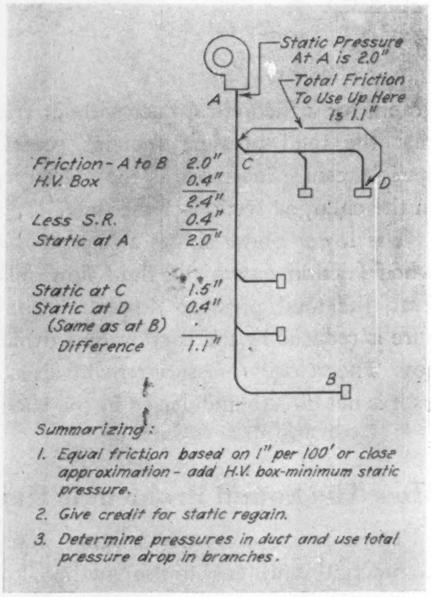
The basic concept also requires that the system be quiet, or quieter than systems of conventional design for similar occupancy, and shall be flexible as to control through the range of accurate individual room control to good zone control. Most important of all, the system must provide high quality air



Duct	Velocity, fpm	T.D., F	Duct Size, in.	Area, sq ft	Insulation, sq ft per lin ft	Weight, lb per lin ft	Weight Saving, Percent
A	2000	20	36x12	3.0	8.0	10.2	—
B	4000	20	18x12	1.5	5.0	7.7	25
			*16 dia	1.4	4.2	6.5	35
C	4000	30	12x12	1.0	4.0	6.2	40
			*13 dia	0.9	3.4	5.2	50

*Circular equivalent of rectangular duct for equal friction

2 DUCT SIZE can be varied in relation to velocity and temperature differentials to effect savings of space, metal, and insulation



Summarizing:

1. Equal friction based on 1" per 100' or close approximation - add H.V. box-minimum static pressure.
2. Give credit for static regain.
3. Determine pressures in duct and use total pressure drop in branches.

3 THIS DUCT SYSTEM illustrates a simplified method of sizing main duct and branches

diffusion, even when using high temperature differentials limited only by the operating characteristics of the heat transfer and refrigeration cycles.

If each phase of this basic concept is systematically analyzed, it can be proved that this new design technique is changing an industry because it is based on sound engineering. It is so sound, in fact, that its acceptance is recognized not only by engineers in the U. S., but also in Mexico, Canada and Europe.

A simple diagram, Fig. 2, shows the objective, with the general relation of duct sizes, insulation and weights changing as the velocity and temperature differentials are varied.

Consider a main duct that must be designed to handle a constant sensible cooling load. If the velocity is increased from 2000 to 4000 fpm, the duct can be cut in half and a 25 percent saving in metal and a 50 percent reduction in shaft space is obtained. If the temperature differential is increased from 20 to 30 F, the duct can be reduced to one-third its original size, resulting in a 50 percent saving in metal. These percentages, of course, cannot be applied to complete systems, since they apply only to the instantaneous conditions in a main supply duct. As complete systems are analyzed, other economic variables reduce these percentages.

II HOW TO SIZE HIGH VELOCITY DUCTS

The sizing of high velocity ducts is a controversial subject. A method that has been found to be easy and accurate to use in practice, and is based on fundamental fluid flow laws, is described here. Many capable engineers have used it for good air conditioning systems that have performed as designed. This method really is a combination of *three* commonly used methods: Equal friction, static regain and total friction.

Let's start with a velocity of approximately 4000 fpm in the distribution supply duct at the plenum of a blow-through system, or at the fan of a pull-through system. Although higher velocities can be used, the figure of 4000 fpm is being used for two important reasons. At this time, as contractors are becoming versed in the art of high velocity duct fabrication, the problem of noise generation within the duct due to sharp edges and the like is of little importance at 4000 fpm. Secondly, and more important especially in large systems, experience has shown that this velocity is near the top limit when the objective is a reasonable fan horsepower to suit the economic pattern.

1) *Equal Friction.* To simplify the explanation, let's assume that the diagram in Fig. 3 shows the distribution system starting at 4100 fpm and that the main duct, which is the important factor in the determination of fan horsepower, is 200 ft in equivalent length. Using the standard friction chart, begin sizing by intercepting the capacity and the 4100 fpm line. Then, as capacity is changed, follow straight down the 1 in. per 100 ft line to select the duct sizes as the capacity is further reduced by the take-offs (Fig. 4). As smaller sizes are selected, the velocity will drop rapidly so that near the end of the duct run the velocity is equal to or, in many cases, less than the velocity in a conventional system. This is an advantage, because it would be illogical to impose a friction penalty on a main distribution fan to push a small quantity of air at high velocity through a small, high friction duct at the tail end of a system.

To the friction of 2 in. per 200 ft equivalent length of duct at 1 in. per 100 ft, add the minimum static of the attenuator diffuser combination. This value varies greatly, but for this example we use 0.4 in., which is a fair average.

2) *Static Regain.* In step two, consideration must be given to the static regain in the main duct. This is important as there is a lot of kinetic energy in high velocity air. The standard friction chart cannot make allowances for this factor. The static regain can be easily worked out as follows:

$$\begin{aligned}
\text{Theoretical regain} &= (V_1/4005)^2 - (V_2/4005)^2 \\
\text{Practical regain} &= 0.5[(V_1/4005)^2 - (V_2/4005)^2] \\
\text{Substituting, the} & \\
\text{Practical regain} &= 0.5[(4100/4005)^2 - \\
&\qquad (2000/4005)^2] \\
&= 0.5(1.02 - 0.25) \\
&= 0.5 \times 0.77 \\
&= 0.39
\end{aligned}$$

The figure of 0.5 in. in the second equation is an average value used by practical designers and takes into account the changes in shape or direction encountered in most systems. Under ideal conditions 0.7 or 0.8 of the velocity head is actually recovered, the balance being dissipated in dynamic losses.

3) *Total Friction.* The third step requires the use of total friction as the branch ducts are sized. After establishing the sizes of the main duct as described in steps (1) and (2), the engineer then determines the static pressure in the main duct at the branch intercepts. Then, knowing the minimum pressure required at the attenuator, the difference between this pressure and the main duct pressure should be used up by transmitting air at high velocity to save metal without affecting the fan horsepower and, at the same time, reduce the sound attenuating load from the diffuser attenuator combination.

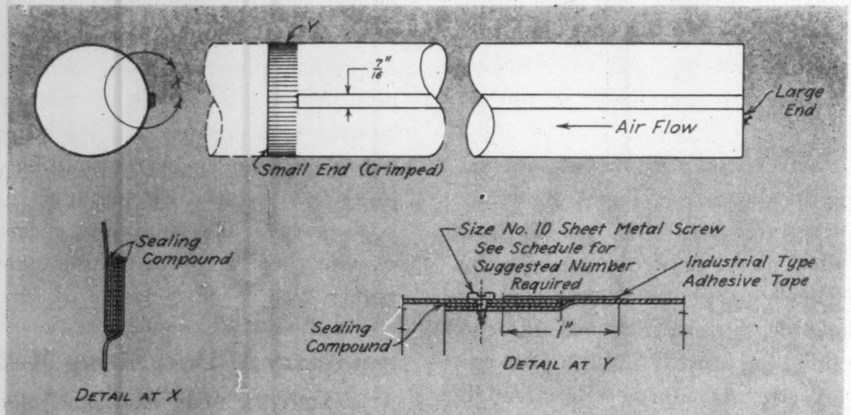
Summary of Duct Sizing Method

1) Start the main duct at a velocity of approximately 4000 fpm and use the equal friction method to size the duct, following down the 1 in. per 100 ft. line on the standard friction chart. Add to the duct friction the minimum static pressure of the attenuator-diffuser. The minimum static pressure of the attenuator-diffuser combination is the pressure at its inlet to get the specified amount of air through the combination when the valves are in the wide open position.

2) Determine the static pressure regain, using the basic formula, and deduct it from the sum of the main duct friction and the minimum static pressure of the attenuator-diffuser combination. This is the portion of the pressure which the fan must supply to move the air from the beginning of the main duct and diffuse it into the occupied space.

3) Determine the main duct pressures at the branch duct intercepts. Deduct from this value the minimum pressure of the diffuser-attenuator combination and use this difference by the total friction method by pushing the air into the branches at high velocity to save metal and reduce the static pressure and consequently the sound absorbing load on the attenuator. This calculation does not affect the fan at all, since the main duct calculation is not affected by this step.

The last 50 ft of run of the main duct, which determines the fan static, should be studied carefully. This section of the duct is a critical section when an economical system is being designed. For example, when selecting the diffuser-attenuator combination, close attention should be paid to the minimum static pressures of the attenuator-diffuser combinations. Refer to Fig. 13 and note that for 300 cfm a Unit "B" with a size 20 diffuser requires a minimum static of 1.2 in. However, it will also be noted that a Unit "C" or a larger attenuator with a size 20 diffuser re-


Y
7/16"
Large End
Air Flow
Small End (Crimped)
Sealing Compound
Detail at X
Size No. 10 Sheet Metal Screw See Schedule for Suggested Number Required
Industrial Type Adhesive Tape
Sealing Compound
1"
Detail at Y

Duct Size Diameter, in.	Sheet Metal Gage No.				Minimum No. of Sheet Metal Screws per Joint
	Steel		Aluminum		
	Ducts	Fittings	Ducts	Fittings	
Up to 8	24	22	22	20	3
Over 8, to 18	22	20	20	18	4
Over 18, to 30	20	18	18	16	6

4 DUCT CONSTRUCTION details which have been used for static pressures up to 5 in.

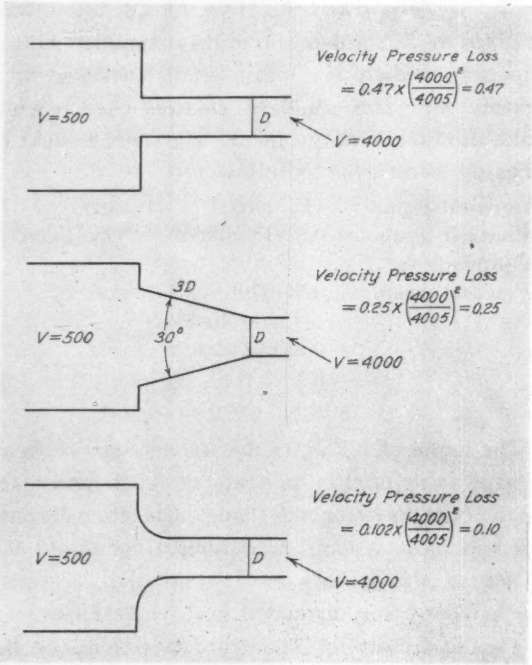
quires a minimum static of only 0.5 in. This small investment in larger size attenuators near the end of the line would, in this case, take a 0.7 in. static load off the fan. Low velocities in small ducts and proper selection of streamlined take-offs will also reduce the fan static and horsepower.

III DUCT CONSTRUCTION

There are broad discrepancies in the specifications for high velocity ducts. The duct construction, of course, must be strong enough to handle the internal pressures, but the objective is to get the advantages of high velocity with reasonably low pressures. Fig. 4 shows details of duct construction which have been used in distribution systems with static pressures up to 5 in. If the design method just described were used, it would mean that the details would be suitable for duct runs up to 500 ft in equivalent length. Dampers are not necessary and are really undesirable in high velocity ducts. The special dampers in the attenuating boxes are designed to do all the balancing.

Taper Plenum and Fan Take-Offs

When designing high velocity systems, the engineer must be alert to other conditions in the duct system which could impose substantial penalties on the fan. For example, the transition from the plenum to the distributing duct could impose a severe penalty


Velocity Pressure Loss
$= 0.47 \times \left(\frac{4000}{4005}\right)^2 = 0.47$
V=500
D
V=4000
Velocity Pressure Loss
$= 0.25 \times \left(\frac{4000}{4005}\right)^2 = 0.25$
3D
30°
V=500
D
V=4000
Velocity Pressure Loss
$= 0.102 \times \left(\frac{4000}{4005}\right)^2 = 0.10$
V=500
D
V=4000

5 VELOCITY PRESSURE LOSS can be decreased by streamlining duct approaches due to the "vena contracta" and the loss caused by lack of streamlining.

In Fig. 5 the top diagram shows that an abrupt velocity change will cause a loss of 0.47 in. If some streamlining is done, as shown in the middle diagram, this figure is practically cut in half. If the streamlining is improved to the bell mouth entrance, a further reduction in the pressure loss is obtained. This same technical logic applies to the approach from the fan to coils. In fact, many engineers are getting away from the old fashioned plenum. The neatest and most economical layouts have a tapered approach from the fan to the coils as the velocity is changed from the outlet velocity of the fan of, say, 2500 fpm to the coils with a face velocity of 500 and then a tapered approach to the high velocity duct with a velocity of approximately 4000 fpm.

Sound Traps May Be Needed

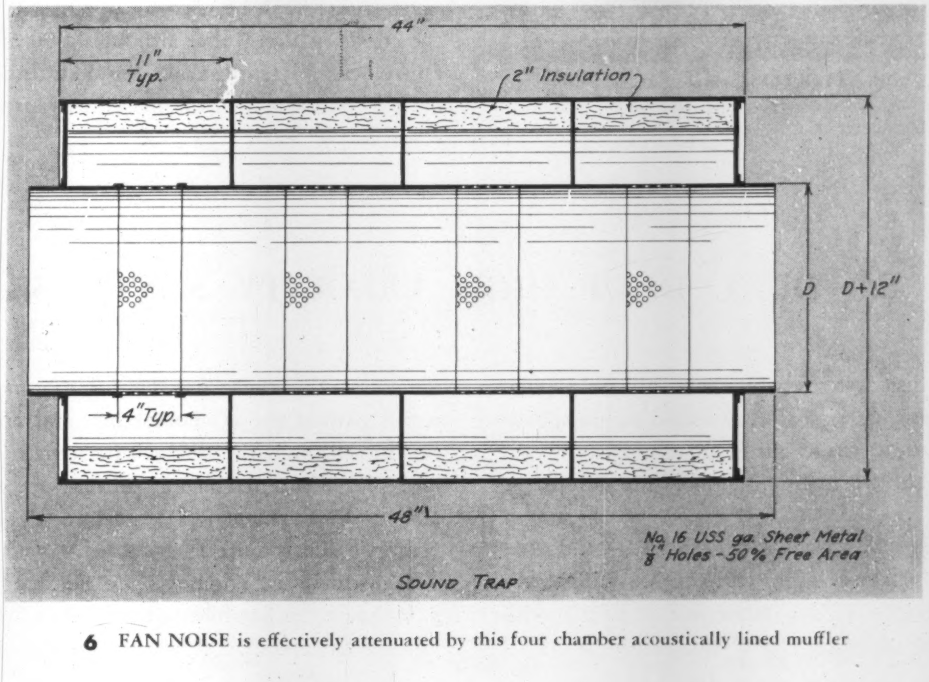
Although many heating and air conditioning engineers are cautious and worried about sound, and this is understandable, the record shows that practically all well designed high velocity systems are more quiet than most low velocity conventional systems. This is logical because every diffuser has a scientifically designed, factory made attenuator in series with it and the distribution duct.

Diffusers also accomplish their purpose with better efficiency on high velocity systems because the attenuator acts as a "plenum approach." This type of approach is far superior to close coupled take-offs and, in many cases, badly installed or adjusted accessories.

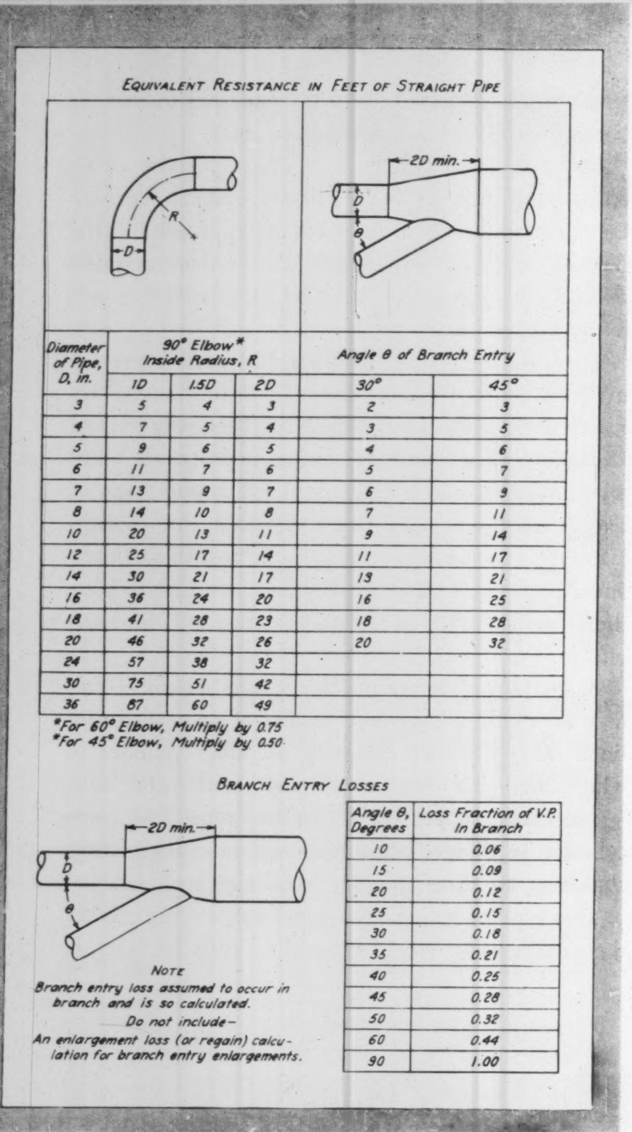
The problem of sound traps for fans is present in every high velocity design. Unfortunately, research on this important subject has been very limited and some of it has been rather impractical. Until all fans are acoustically modernized, sound traps of two general types are being installed. An elementary type is a section of duct with acoustical lining and a perforated plate or wire mesh covering to keep the acoustical material from separating and "blowing off."

A sound trap of the muffler type is shown in Fig. 6. It is only 4 ft long and consists of an acoustically lined outer cylinder enclosing an inner cylinder in which there are sections of perforated metal with 1/8 in. holes, 50 percent of the free area. The outer cylinder is divided into four separate attenuating chambers by three annular dividing rings.

This type of trap does a good attenuating job on the troublesome low frequency sounds. It also is



6 FAN NOISE is effectively attenuated by this four chamber acoustically lined muffler



EQUIVALENT RESISTANCE IN FEET OF STRAIGHT PIPE

Diameter of Pipe, D, in.	90° Elbow* Inside Radius, R			Angle θ of Branch Entry	
	1D	1.5D	2D	30°	45°
3	5	4	3	2	3
4	7	5	4	3	5
5	9	6	5	4	6
6	11	7	6	5	7
7	13	9	7	6	9
8	14	10	8	7	11
10	20	13	11	9	14
12	25	17	14	11	17
14	30	21	17	13	21
16	36	24	20	16	25
18	41	28	23	18	28
20	46	32	26	20	32
24	57	38	32		
30	75	51	42		
36	87	60	49		

*For 60° Elbow, Multiply by 0.75
*For 45° Elbow, Multiply by 0.50

BRANCH ENTRY LOSSES

Angle θ, Degrees	Loss Fraction of V.P. In Branch
10	0.06
15	0.09
20	0.12
25	0.15
30	0.18
35	0.21
40	0.25
45	0.28
50	0.32
60	0.44
90	1.00

NOTE
Branch entry loss assumed to occur in branch and is so calculated.
Do not include–
An enlargement loss (or regain) calculation for branch entry enlargements.

7 LOSS OF VELOCITY pressure at take-offs above is for varying angles and lengths of pipe

obvious that the pressure drop is no more than is obtained through 4 ft of the main high velocity duct.

Duct Take-offs and Fittings

There are important factors in systems of this type, especially in that section of the duct where the velocities are high. In the 4000 fpm section, a 90 deg tee loses all the velocity pressure, which is 1 in. This phenomenon can be capitalized on where short branches are used to serve attenuators located close to the fan. The loss of pressure here is an advantage, since it removes a static killing load from the attenuator and, in a sense, increases its capacity. Or, if the static is killed by proper take-off selection, it may be possible to use smaller, less expensive attenuators.

Conversely, when a reasonably long branch is being used, the designer should use the acute angle Y fitting and capitalize on the pressure saved to drive the air through the branch at high velocity, so that smaller ducts can be used to save metal. Note from the charts in Fig. 7 that although a 90 deg tee loses all velocity pressure, a 30 deg Y fitting loses 0.18 or less than one-fifth of the velocity pressure.

IV DUAL DUCT HIGH VELOCITY SYSTEMS

The dual duct systems, which were always popular in the western states, have increased in popularity throughout the entire country and Canada with the advent of high velocity, high temperature differential systems.

The ducts for high velocity systems — and especially high velocity, high temperature differential induction systems — are small and require a minimum amount of space and metal. Access doors are unnecessary, because the damper motors are an integral part of the attenuator box and are easily accessible through the diffuser for repair, adjustment or replacement. Balancing, because of pressure balancing developments, is comparatively easy to accomplish and is quite accurate.

Unfortunately, engineers are not taking full advantage of the flexibility of dual duct, high velocity systems to capitalize on its control features.

Under-the-Window Perimeter Units

Among the various types of dual duct units being used are the under-the-window perimeter units. They are excellent for exterior zone year 'round air conditioning. In many installations, the 100 percent induction type is generally used, as it provides good diffusion on the cooling cycle. The units provide ample ventilation air and can be used without operating the refrigeration equipment.

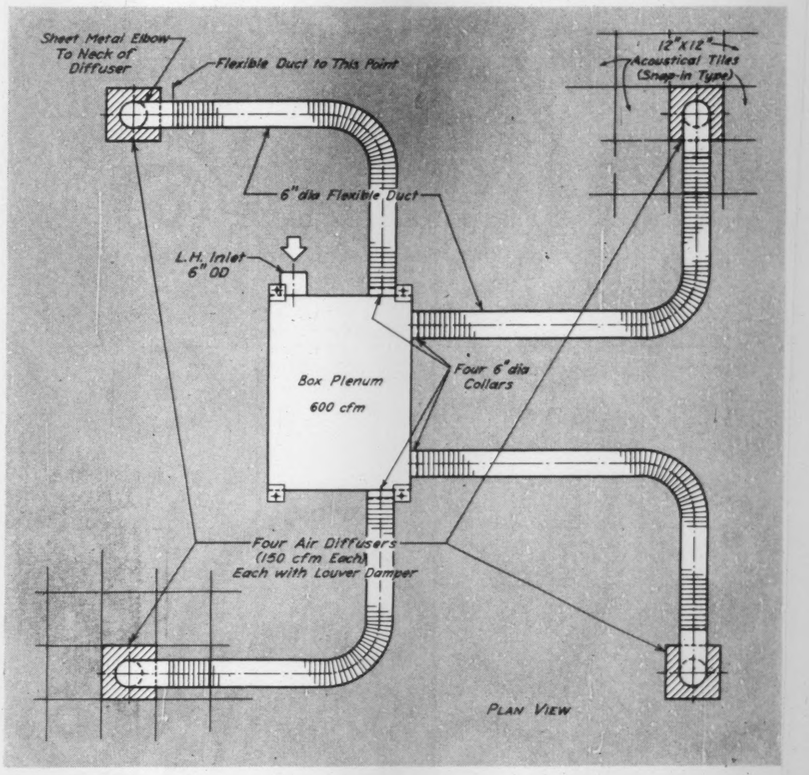
When individual room control is not required, single duct, under-the-window induction type high velocity units are being used to the satisfaction of many users. It should also be noted that high velocity under-the-window units are being used in low buildings as well as the multi-story type. High velocity ducts can be used for horizontal as well as vertical distribution of air.

Ceiling Units for Interior Zones

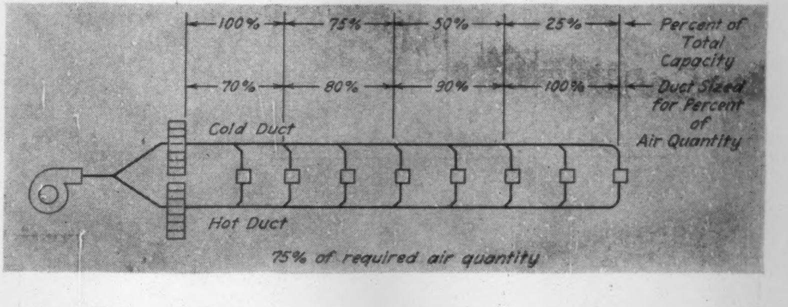
Various applications of dual duct high velocity systems are now being used, some of which are as follows:

1) *Individual Unit System.* This type of application, which results in very accurate control, requires a dual duct valve and actuator at each diffuser. The units are then controlled by individual thermostats or one thermostat controls two or more diffusers. For example, one thermostat may control as many as four diffusers in a large office or a bay.

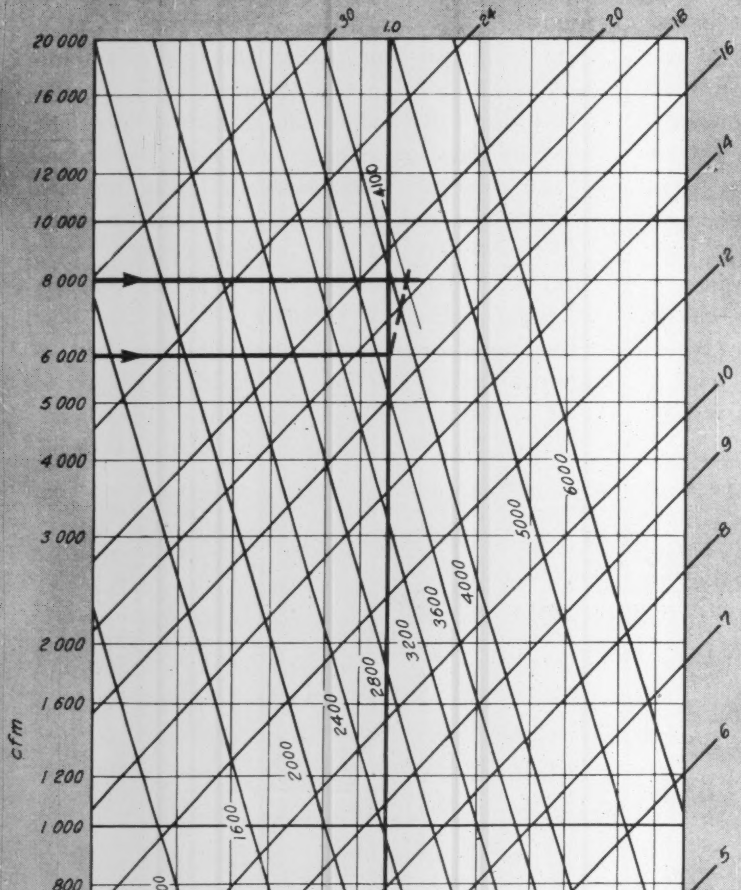
2) *Combination High, Low Velocity Systems.* A popular design is to place a large dual duct valve attenuator unit in a bay and tap it in as many as four places and run low velocity flexible ducts to four diffusers in a bay or large office. This scheme, nicknamed for obvious reasons the "octopus system,"


Sheet Metal Elbow To Neck of Diffuser
Flexible Duct to This Point
12"x12" Acoustical Tiles (Snap-in Type)
6" dia Flexible Duct
L.H. Inlet 6" OD
Box Plenum
600 cfm
Four 6" dia Collars
Four Air Diffusers (150 cfm Each) Each with Louver Damper
Plan View

8 "OCTOPUS SYSTEM," with large dual duct valve attenuator unit at center, has low velocity flexible ducts which permit easy re-location of diffusers


100%
75%
50%
25%
Percent of Total Capacity
70%
80%
90%
100%
Duct Sized for Percent of Air Quantity
Cold Duct
Hot Duct
75% of required air quantity

9 IN DUAL DUCT DESIGN, the most difficult problem is the probability factor. Method at right divides the system in four parts, based on capacity. The hot duct is sized for 75 percent of the cold duct size. No set rule can be made because of design, climate and safety factors



10 A STANDARD friction chart may be used in determining pressure losses in straight ducts. Examples in which the chart is used are given in the text permits great flexibility, especially when tenant changes or partition changes may be necessary. The flexible ducts permit easy re-location of the diffusers to suit the changes. (See Fig. 8)

A broader application of this idea is the method of carrying dual ducts to a floor of a multi-story building, providing one large mixing valve controlled by a thermostat in the return air duct and continuing to the individual diffusers by a single duct high velocity system or a single duct "octopus" system.

The Design of Dual Duct Systems

There is no doubt that positive design factors are not available for dual duct systems. This is due to the fact that up to now this fine system, because of its expense and structural and control problems has been used for special applications and, in general, its use was limited geographically to the western and southwestern regions.

The most difficult problem is the probability factor associated with the sizing of ducts. This probability factor is important because it represents the percentage of the total load which the cooling duct must carry in each section and is the factor which capitalizes on a load which is fluctuating due to variations of the sun, lighting and occupancy loads.

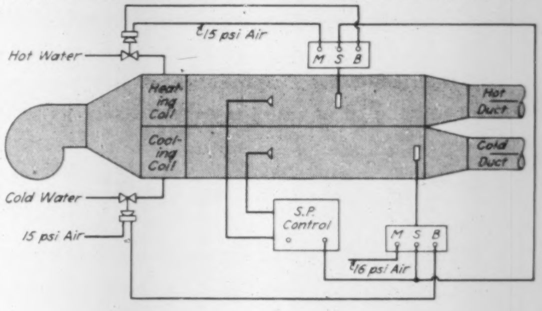
For example, Fig. 9 shows a method of application of probability factors which is being used successfully by engineers in California. The general idea is to divide the system in four parts based on capacity. Then the section farthest from the fan is sized for 100 percent of the designed load. The next quarter section is designed for 90 percent, the next for 80 percent and the next for 70 percent. The hot duct is then sized for 75 percent of the cold duct size.

Many engineers are using factors which are higher than those described above, but no set rules can be made and the engineer must use his judgment as he analyzes his particular design. For example, he will find that for some interior zone designs, when there is a fairly constant year 'round load, the hot duct can be designed to carry about 25 percent of the air capacity of the cold duct. The safety factor, if one is required, can be handled by a more generous sizing of the heating coils.

Pressure Unbalance With Dual Ducts

Engineers are rightfully concerned over a static unbalance between the hot and cold ducts at a particular mixing valve. Unless proper precautions in both duct sizing and controls are taken, the unbalance would occur when a majority of either the hot or cold valves on a particular zone were closed by thermostatic action. The unbalance would be due to the pressure which would be built up in a duct because of the reduced flow. The temperature in the space would not be changed but the output of the diffuser would be increased and, unless the attenuators were conservatively sized, the sound level at the diffuser would be increased beyond the design level.

TYPICAL CONTROL SYSTEM FOR DUAL DUCT AIR CONDITIONING SYSTEM



Sequence of Operation

1 – Static pressure instrument air pressure determines control point of submaster duct thermostat.

2 – Submaster duct thermostats control coils to maintain temperatures.

3 – Static pressure instrument senses difference in static pressure between the two ducts and varies output air pressure accordingly.

Average Cold Dampers	Average Hot Dampers	Instrument Branch Pressure	Cold Duct Submaster Control Point	Hot Duct Submaster Control Point
75% Closed	25% Closed	13 lb	Bypass	100°
50%	50%	8 lb	60°	80°
25% Closed	75% Closed	3 lb	50°	Bypass

11 STATIC PRESSURE CONTROLLER eliminates the problem of pressure unbalance with low velocity dual ducts. Sequence of operation is outlined above

This problem has been eliminated or diminished to a point of no concern by an ingenious control application which has been used successfully on low velocity dual duct systems. See Fig. 11. The basic idea is a static pressure controller actuated by pressure sensing devices in both the hot and cold ducts. If, for example, as radiation increased and the hot-side valves of a lot of units started to close, flow would be reduced and pressure would be built up. The sensing device would note this condition and reduce the temperature of the hot duct which would increase the flow again and restore reasonable balancing. This control relies on temperature variations rather than dampers, with the objective of keeping the flow fairly constant in both the hot and cold ducts.

It is the author's opinion that the problem of static unbalance at units is overstressed, as well designed attenuators can handle a reasonable amount of unbalance without a noticeable effect. If the engineer sizes the ducts in accordance with recommendations stated herein where medium pressures are used in conjunction with reasonable controls, the problem no longer exists.

V DESIGN DETAILS

There is no doubt that fan hp is the major problem of high velocity systems, but it has been shown herein that logical duct design reduces this problem to one of practical acceptance. The comparison of fan hp in low and high velocity systems can easily be made. It must be remembered that in high velocity design, the basic system is essentially the same as a low velocity system, the main difference being the distribution system from the plenum to the room. Therefore, to compare the horsepower, it is only necessary to isolate and study the influence of these sections of the system on the hp.

If we assume that the pressure loss in both a low velocity and high velocity system is 1.5 in. to produce

$$hp = \frac{QP_s}{6356} = \frac{Q(PS_1 + PS_2)}{6356}$$

Assume — PS_1 = Static Pressure — Air Handling Equipment (Air Intake, Coils, Filters, etc.)

PS_2 = Static Pressure — Supply Duct System

Then —

$$hp\ (Low\ Velocity) = \frac{Q(1.5 + 0.5)}{6356} = \frac{2Q}{6356}$$

$$hp\ (High\ Velocity) = \frac{Q(1.5 + 2.5)}{6356} = \frac{4Q}{6356}$$

Double Temperature Differential -

$$hp = \frac{\frac{1}{2}Q\,(1.5 + 2.5)}{6356} = \frac{2Q}{6356}$$

12 FAN HORSEPOWER in high and low velocity systems can be compared by studying the influence of the systems on the horsepower

13 **DIFFUSERS AND PRESSURE** reducing sound attenuator chambers are selected on the basis of the static pressure that will be imposed on the attenuator, the decibel rating and the capacity

Capacity cfm	Radius of Diffusion Min. Max.	Unit "A"						Unit "B"						Unit "C"					
		Diffuser Size	Min. S.P.	Decibel range				Diffuser Size	Min. S.P.	Decibel range				Diffuser Size	Min. S.P.	Decibel range			
				at min. S.P.	at 1¾ in. S.P.	at 2½ in. S.P.	at 3 in. S.P.			at min. S.P.	at 1¾ in. S.P.	at 2½ in. S.P.	at 3 in. S.P.			at min. S.P.	at 1¾ in. S.P.	at 2½ in. S.P.	at 3 in. S.P.
30	2-4	10	0.05	29	30	31	31												
40	2-4	10	0.1	29	30	32	32												
50	2-5	10	0.15	30	31	32	32												
60	3-6	10	0.2	32	33	34	34												
80	3-7	10	0.3	34	38	40	42												
		12.5	0.25	30	32	34	36												
100	3-8	10	0.5	38	42	43	45	15	0.2	33	34	35	35						
		12.5	0.4	32	34	36	38												
125	4-9	10	0.75	46	48	49	50	15	0.3	34	35	36	38						
		12.5	0.6	36	38	40	42												
150	5-10	12.5	0.9	42	43	44	45	15	0.4	35	37	39	41						
								20	0.3	34	36	38	40						
175	5-11	12.5	1.2	47	48	49	50	15	0.5	39	41	43	44						
								20	0.4	36	38	40	41						
200	5-11							15	0.7	43	44	45	46						
								20	0.6	37	39	41	43	20	0.2	32	35	35	36
225	6-12							15	0.9	45	46	47	47						
								20	0.7	39	40	42	44	20	0.2	33	36	37	38
250	6-13							15	1.1	48	48	48	49	20	0.3	35	37	39	40
								20	0.9	43	43	44	45	25	0.25	33	37	38	38
275	6-13							20	1.0	44	45	46	47	20	0.4	39	40	41	42
														25	0.3	35	39	39	40
300	6-13							20	1.2	46	46	47	48	20	0.5	40	42	42	43
														25	0.4	36	42	41	42
325	7-14							20	1.4	49	49	50	51	20	0.5	42	43	44	45
														25	0.4	39	41	42	43
350	7-15													20	0.6	44	45	46	47
														25	0.5	41	44	44	45
400	7-16													20	0.8	47	49	50	50
														25	0.7	45	47	47	48
450	8-17													25	0.9	48	49	50	50
500	8-18													25	1.0	50	51	52	52
550	9-19																		

flow through the return system, fan, filters and coils, and the loss from the plenum through the diffuser in a low velocity system is 0.5 in., we can substitute in the basic equation to determine the theoretical horsepower of the low velocity system as equal to $2Q/6356$. (See Fig. 12)

In the same equation we can substitute 2.5 in. for the supply duct and attenuator-diffuser combinations, for PS_2 and with PS_1 being the same for both systems to show that the theoretical horsepower is $4Q/6356$ or twice that required for the low velocity system.

If we double the temperature differential for equal sensible cooling, the quantity is reduced to $Q/2$ and the theoretical horsepower is the same as for a low velocity system. This latter assumption is, of course, rather bold as it would be difficult to double the temperature differential from 20 F to 40 F. However, if the temperature differential were increased from 22 F to 30 F, then the equation changes as Q becomes $22Q/30$ and the theoretical horsepower becomes $3Q/6356$, or the increase in horsepower over the conventional system is only 50 percent.

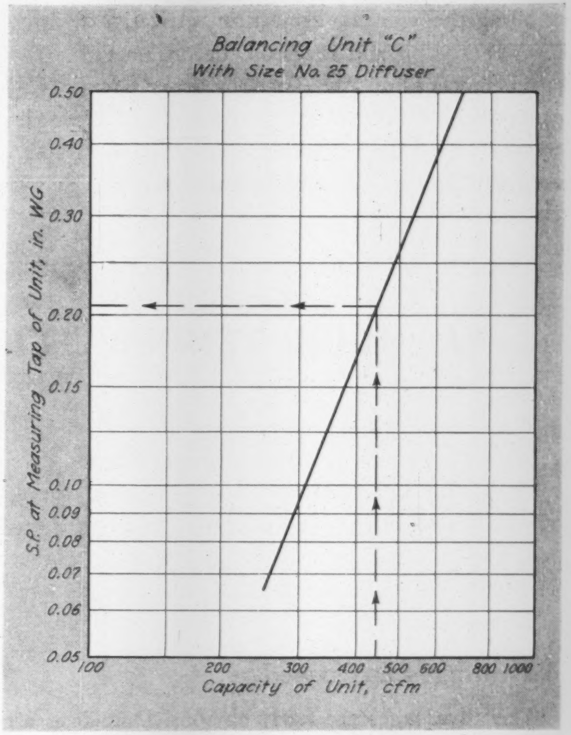
Selecting Attenuator-Diffusers

The selection of diffusers and pressure reducing attenuation chambers is more scientific yet just as easy as selecting diffusers for low velocity systems. The empiric method, based on neck velocity as related to height to maintain a predetermined sound level, cannot be used.

The engineer first selects the sound level he requires for a particular type of occupancy. Recommended levels are given in the ASHVE Guide and other books. For example, the Guide shows:

General Offices 50 decibels,
Department Stores 50,
Hospitals 25,
Factories 65.

Then, selecting the capacity required (Fig. 13), he follows the values in this figure until he reaches the intercept of the selected sound level rating with the static pressure that will be imposed on the unit. It should be noted that the static pressure on the attenuator has an important effect on the sound level of the attenuator. This means that near the fan, where the static is high, larger attenuators are required than for units some distance from the fan, when the static has been reduced by duct friction.



14 A GRAPH like this, plotting pressure vs. cfm of air delivered to the unit, aids quick, accurate balancing of high velocity units. The intercept indicates the correct balancing pressure.

If the units are selected in accordance with the procedure outlined, a sound meter placed 3 ft below and 3 ft off the centerline of the unit will not exceed the designed sound level.

Balancing High Velocity Units

The technique of balancing high velocity units is far superior and more accurate than methods used for balancing low velocity units. The method of scanning the neck to obtain average velocities has often been discarded in favor of pressure balancing. Because the plenum or attenuator at the diffuser is factory made, jet plates can be used as calibrated orifices to measure the flow of air. If a pressure tube is attached to a meter and the pressure is read while measured amounts of air are delivered to the unit, a graphical relation between the two can be plotted.

Using this graph (see Fig. 14), the engineer assigned to balance the systems can quickly and accurately balance the units. From the balancing graph he selects the quantity of air established by the designer along the abcissas. Projecting vertically, he intercepts the graph and reads on the ordinates the correct balancing pressure. Then, by using a screw driver, he sets the valve in the attenuator to the position at which the gage reads the selected balancing pressure. The unit will then be balanced and will deliver the designed quantity of air. Actual field tests have shown that the amount of time required to balance a high velocity system is less than one-half the time required to balance a low velocity system. It is also definitely agreed that the balancing is far more accurate.

VI HIGH TEMPERATURE DIFFERENTIAL SYSTEMS

The subject of high temperature differential, high velocity air distribution and diffusion is being carefully studied by engineers. A few systems are in operation and others are being designed with temperature differentials of 30 F and slightly higher. There are, of course, advantages and disadvantages.

Advantages Discussed

The advantages are fairly obvious. Duct sizes are reduced in the same lineal relation as though velocity was increased. Also, as quantity is reduced for equal sensible cooling, the fan horsepower is decreased and filter size is reduced. The return air system is decreased in direct proportion to the temperature differential increase.

The diffusion of low temperature air, 30 F or more below the ambient, was a problem before the invention of modern types of diffusers. Because the air quantity was reduced, the room air change was cut to a value, which in many cases was below the acceptable limits necessary to produce good diffusion in an occupied space. It is extremely difficult to get good diffusion in a room when there are fewer than six air changes per hr.

The problem of obtaining good diffusion of low temperature air has been solved by either the high aspirating or induction type diffuser. For example, the energy in high velocity systems can be put to work as if a fan were placed in each diffuser. Induction type units are made which induce 100 cu ft of room air for every 100 cu ft of prime air brought to the diffuser through the duct distribution system. This cuts the temperature differential in half, say from 30 F to 15 F, reduces the density and doubles the room air change to get good comfort conditions with draftless diffusion.

Disadvantages Listed

The important disadvantages of high temperature differential air distribution are:

1) The horsepower per ton of refrigeration is increased as the suction pressure is decreased. Savings can be made of course if the peak loads are handled by high temperature differential air and by reducing the differentials when the peaks are passed.

2) There is no increase in the latent load from the occupied spaces as dew point is lowered, but, of course, the latent load from the outdoor air supply is increased. Engineers are nullifying this disadvantage by using chemical dehumidifiers on the outdoor air supply.

3) The relative humidity in the occupied space is lower, but some engineers are designing for a higher ambient to produce an effective temperature still well within the limits of the comfort zone.

Generally, the trend toward the use of high temperature differentials is upward, with many engineers using temperature differentials limited only by the temperature at which the coils would form ice.

In planning duct systems, the flexibility of design, which is an advantage of high velocity systems, is being capitalized upon by many engineers. The combination of high and low velocity systems, and the easy adaptation of individual and group automatic controls, gives the engineer many opportunities to solve what hitherto were complex problems.

• **Air infiltration studies described here show how heating and air conditioning costs can be cut by reducing the air infiltration. One way to do it is to use revolving doors.**

Cut Heating, Cooling Costs

. . . 600 tests show economies of reducing air infiltration at building entrances

By Arthur M. Simpson

Chief Engineer
Revolving Door Div.
International Steel Co.

To THE HEATING and air conditioning engineer a tall building is nothing more than a chimney with a controlled draft at the bottom. This concept may be a strange one to tenants, to the public, and even to building owners themselves. But that's what a tall building is. The controlled draft of this chimney is, or at least should be, the main doorway at street level.

Too often, however, the draft is not controlled. Numerous problems and needless expense for the building owner and operator are the result. As the greatest single air valve in the building, therefore, the street level doorway — there may be several for the building — should not leak.

"Drafty as a Barn"

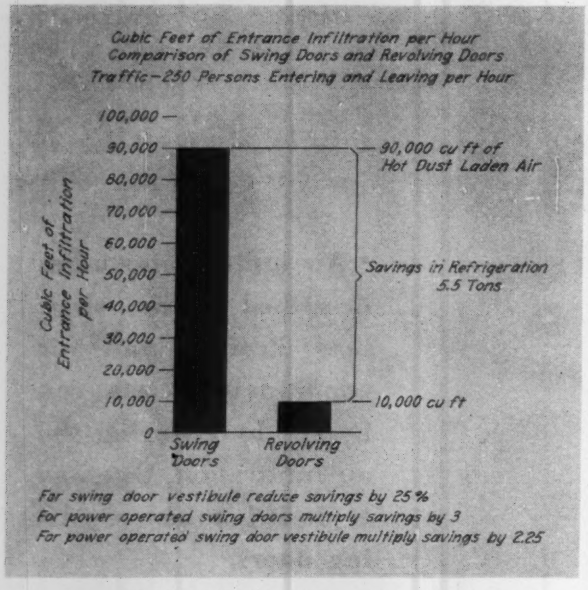
One example of how this leak can be stopped, and net a saving to the owners, is furnished in the experience of the owners of the Fisher building in Detroit. Through several winter seasons, tenants, elevator operators, starters and other personnel complained that they were getting colds and suffering extreme discomfort because the lobby and elevators were "as drafty as a barn." All the time, the heating system was working at full load.

Great amounts of fuel were being burned and employees' time was being lost through illness. Finally, when the owners decided that they could no longer put up with the excessive drafts originating at the main entrance, the doors which had been first installed were replaced with ones that didn't leak air.

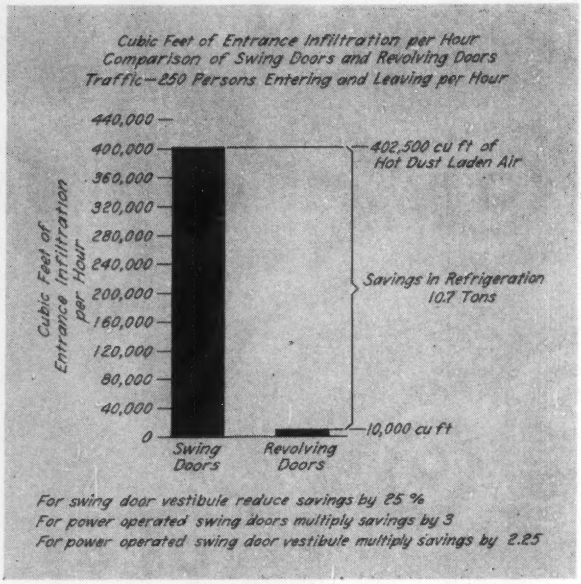
For similar reasons, entrances were recently replaced at the Fisk building in New York, the Detroit bank in Detroit, the Bell savings and loan association in Chicago, the John Hancock life insurance building in Boston and other prominent buildings in key cities.

Wasted Fuel a Big Item

The direct cause of these difficulties was that every time one of the old doors opened, 1100 cu ft or more of



WITH NO EXHAUST ventilation, a saving of 5.5 tons of air conditioning capacity resulted



WHEN EXHAUST ventilation was used, almost double the capacity was saved

cold winter air streamed in, depending on the wind velocity. The amount of fuel used to offset the cooling effects of this cold air was completely wasted. As can be seen from the accompanying charts, the amount of steam poundage and dollar loss which resulted was considerable. In the case of a 31 story building like the Fisher building, whose entrances are used by an average of 15,000 persons a day, the dollar cost of the resulting heat loss ran as high as $6400 in a year's time.

The matter of employees' sickness can often assume major proportions, not only from the standpoint of the payroll, but also on the basis of humanitarianism and loss of employee morale. Incidence of sickness may increase as much as 100 percent in banks, stores and other buildings with leaky doors. During the past year, a St. Louis department store replaced its entrance because so many employees became ill.

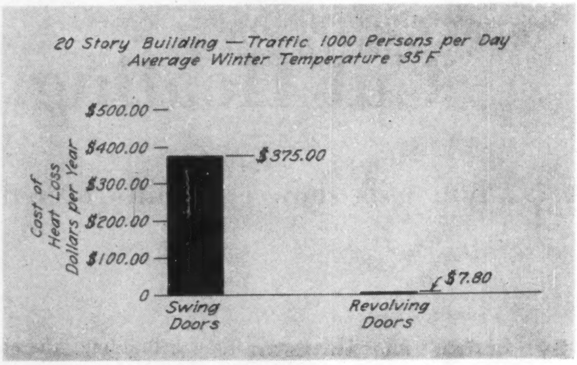
Scientific Tests Made

Building operators have learned through actual experience that heat losses, cool air losses — where air conditioning systems are used — and other conditions resulting from leaky doors cost money. Accurate engineering knowledge on this "entrance infiltration" of air has now been obtained from actual tests conducted in more than 600 entrances in Washington, Boston and Chicago.

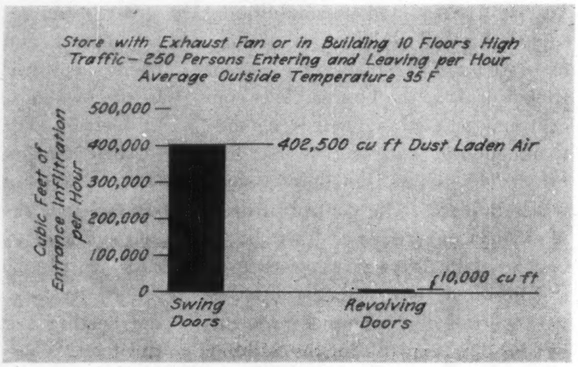
This research showed that the study of entrance infiltration divides itself into three categories:

(1) Infiltration caused by wind pressure, chimney effect in heated buildings and exhaust fan effects during the heating season.

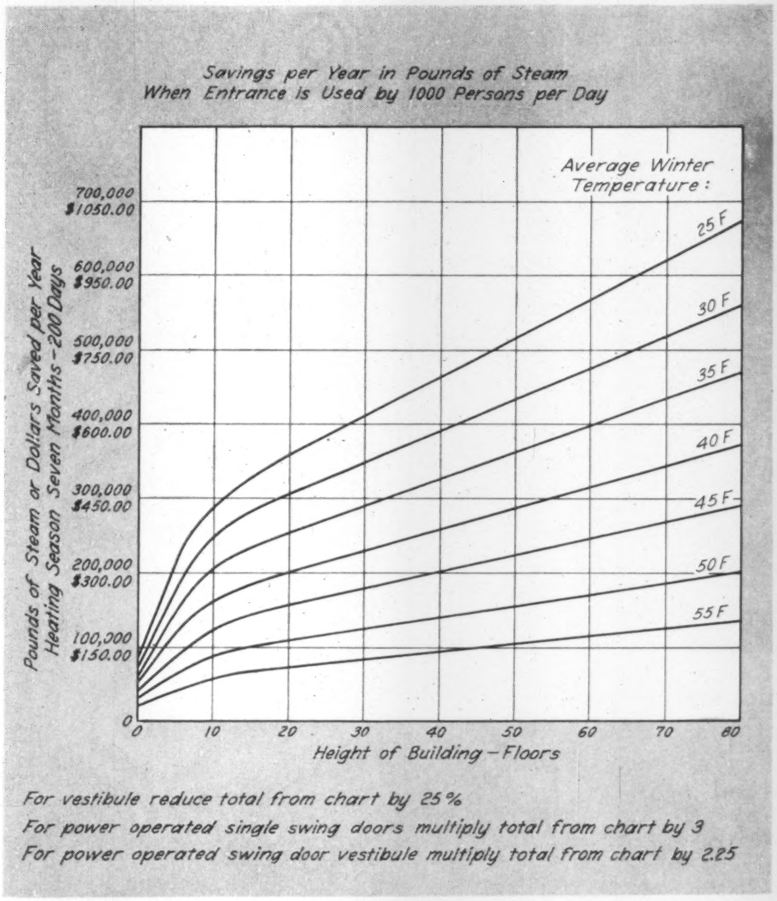
(2) Infiltration and exfiltration caused by wind pres-



HEAT LOSS in dollars due to infiltration through swing doors and revolving doors is compared here



INFILTRATION through swing doors was found to be greater than with revolving doors


Savings per Year in Pounds of Steam When Entrance is Used by 1000 Persons per Day

For vestibule reduce total from chart by 25%
For power operated single swing doors multiply total from chart by 3
For power operated swing door vestibule multiply total from chart by 2.25

SAVINGS PER YEAR for different heights of buildings and outdoor temperatures with revolving doors are given here

sure acting on two or more entrances in different outside walls around a given area in which comfortable temperatures and low humidity are to be maintained during hot weather.

(3) Infiltration and exfiltration around a single entrance in an air conditioned area.

Tests were conducted under scientifically controlled conditions, both in actual buildings and in the laboratory. A specially invented "smoke puffer" was used to demonstrate the direction of air flow. Blocks of ice were used in conjunction with a revolving door test chamber. Many other testing devices and methods were also employed.

Some Test Findings

In many instances, in cold weather where wind velocities were comparatively low, it was found that 1100 cfm of air flowing into a building per opening was conservative. In some buildings with a single entrance, infiltration of 3500 cfm air was noted. In one tearoom with multiple entrances, infiltration was at the rate of 5400 cfm. Other tests showed much higher figures.

It was found, with hot summer air rushing in at 150 to 225 cfm without exhaust fans and 600 to 800 cfm with exhaust fans cfm — and with every single door opening offsetting the cooling effects of the air conditioning systems to such a marked degree — that a building with leaky doors can cost the owner 25 percent more for air conditioning than would the same building with revolving doors.

Leaky doors in one story buildings, as well as in taller ones can represent towering costs for the owner in heating, air conditioning and other factors.

'Stack Draft' a Problem

It is the tall building, however, that creates a "chimney effect" which can result in another problem — a condition known as "stack draft," noted with swing doors. Every opening of a door creates an interchange of inside and outside air subject to extreme temperature variations in the winter. Frosty air rushes in on the ground floor when one of the doors is opened and rises to the top of the building when it becomes heated.

The resulting draft creates a sucking effect in the area behind the entrance in the area of the lobby. This "stack draft" tends to keep the doors closed, since most of them open from the outside.

Quoting a few more figures from these exhaustive tests, it was found that under summer conditions a 36 in. wide door in a multiple entrance store causes an infiltration volume of 165 cu ft for each person passing through during moderate wind velocity. Even with a vestibule, it was found that one person will permit infiltration of 128 cu ft going through a door under the same conditions.

Revolving Door Cuts Losses

One characteristic of a revolving door under these conditions is that it is "always opened, always closed." Infiltration is negligible, amounting to only 18½ cu ft per person under average design conditions.

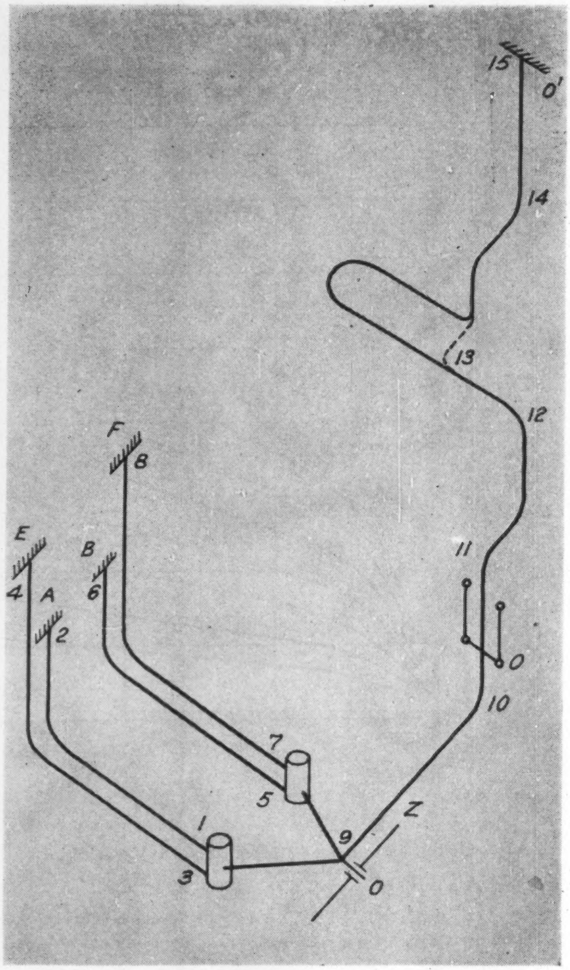
It was found that 24,000 cfh of air infiltration represents one ton of refrigeration under design conditions. Therefore, in a multiple entrance building having an infiltration loss of 165 cu ft per person entering the building, the passage of 150 persons through an entrance in an hour represents a loss of 1 ton of refrigeration.

Designing Steam Piping Systems

. . . .for large central stations requires complete flexibility calculations. Failures and forced outages may be reduced by thorough analysis

By R. L. Jackson and L. H. Johnson

Large Steam Turbine Generator Dept.
General Electric Co.

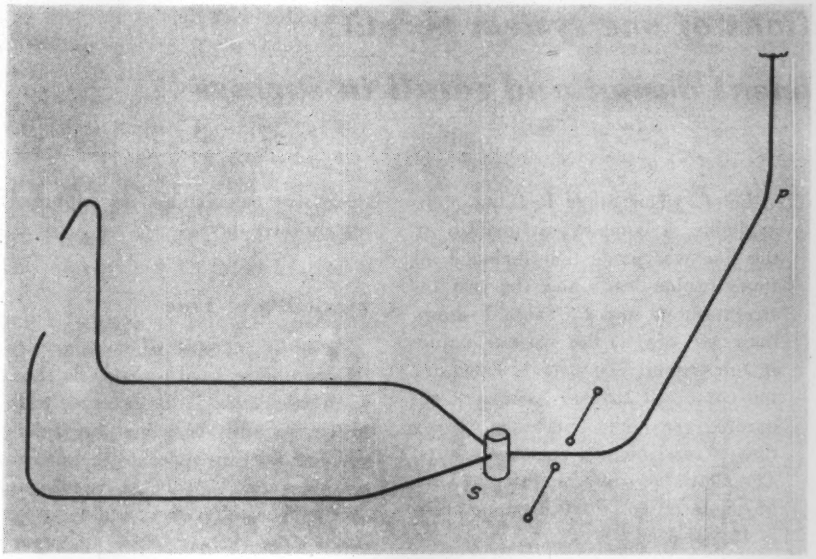


1 THIS MAIN STEAM LINE with two restraints illustrates the point that calculation of five alternate conditions by punched card machines would have eliminated an 80 ft expansion loop of forged and bored piping.

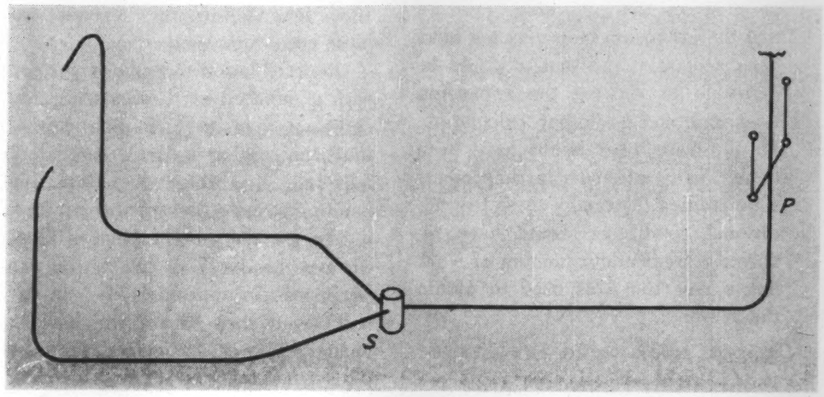
• The authors point out in this paper the need for more complete and accurate flexibility calculations on power piping systems. A method is described whereby a reliable analysis can be made on a production line basis that will produce more efficient designs, resulting in good possibilities for savings in initial costs. Attention also is called to the necessity of actual field checks of movements on installations to verify that the systems perform as expected.

THE IMPORTANCE of designing steam piping systems for power generation in large central stations has increased manyfold in the last few years and all indications are that it will continue to do so.

In the past, steam conditions were low by comparison with those in general use today and piping was comparatively thin walled. It was general practice to provide ample flexibility and the systems were simple enough that analysis was not complicated. The material was carbon steel or low alloy with enough ductility to relieve high stresses if they were present. Usually there was only one pipe connecting the boiler and turbine, and the expansion forces and mo-



2 HORIZONTAL TIE RODS are one type of restraint that can be installed to protect smaller pipes on the end of a system, where moments are usually greatest, from any mis-operation of the hangers.



3 SOLID ROD VERTICAL HANGER, usually installed at the turbine center line, protects turbine leads from excessive downward thrusts and moments and picks up any errors in support of the entire system.

ments applied at the end points were not limiting factors.

Today, with average temperatures of 1000 F and higher, pressures of 1450, 1800 and 2000 psi and the very large ratings used, steam pipes have become heavy walled, expensive items.

The general use of the reheat cycle means a large increase in the number of pipes connecting the boiler and the turbine, and the combined effect of the expansion forces and moments of all the pipes on the end points becomes a limiting factor. This is particularly true of the turbine, where alignment must be maintained within very close limits.

These factors along with the need to keep costs at a minimum and reliability at a maximum make it essential to do a thorough, accurate analysis of piping system flexibility.

The Design Problem

The general practice in designing a piping system is to make a layout of the piping connecting the end points, using intuition, and to analyze the expansion reactions, taking into account movements of the end points. This check for flexibility, if done by a full elastic analysis, becomes very complex in a modern piping system. It involves simultaneous equations which represent six times the number of end points minus six, plus additional ones for intermediate restraints. As an example, the system shown in Fig. 1 involves 26 simultaneous equations.

Tight production schedules and the large amount of other work dependent on piping layout have made it impractical in most cases to do the solution of these simultaneous equations, with their many chances for arithmetical error. Consequently, many simplifying assumptions are made and short cut methods used to analyze the systems. It is recognized that these assumptions and short cuts introduce inaccuracies. To compensate, piping systems have been overdesigned from a flexibility standpoint.

> ***" Several calculations of one system permit more efficient design and result in savings "***

Benefits of Thorough Analysis

In the short cuts used, some assume free floating points in a system as being fixed, some lump several branched lines into one, while others consider only a part of the entire system. That these assumptions will result in overdesign and will also produce questionable results is pointed out by the following example of an actual installation and the calculations that were initially performed on it.

Fig. 1 shows an isometric view of the main steam line from the boiler at *O′* through the two stop valves and to the four terminal points *A*, *B*, *E*, and *F* on the turbine. There is a solid rod hanger at point *C* preventing vertical movements only and a horizontal restraint at *O* preventing horizontal movements in a direction transverse to the turbine center line.

An initial calculation was made from *C* to *O′* considering both ends, fixed against all rotations and deflections. This calculation indicated the need for the expansion loop between points 13 and 14. It gave no reliable answers as to what reactions were being applied to the turbine, nor did it give any indication of what the stresses were in the smaller turbine leads.

TABLE 1—STRESSES in the System

Point	Stress	Point	Stress
1	5469	9	3605
2	5463	10	3600
3	5466	11	3600
4	5462	12	3600
5	5492	13	3810
6	5474	14	3874
7	5462	15	4335
8	5474		

TABLE 2—PUNCHED CARD Results for five conditions

Run No.	Condition	Maximum stress	Point
1	No intermediate restraints	6738	2
2	Y-stop at C	6789	2
3	Y-stop at C; Z stop at O	5492	5
4	Eliminate expansion loop no intermediate restraints	18,490	2
5	Same as run No. 4 but using a Z stop at O	11,327	2

Later, when other facilities were available, a complete calculation of the line was made that included all four turbine leads and the two restraints at *O* and *C*. Table 1 shows these stresses at the various points in the system. The stresses listed are the combined stresses calculated according to the "principal stress theory" and include pressure effects. The allowable stress for this 2¼ Cr-1 Mo material and 1050 F temperature is 15,600 psi.

The stresses, which are low compared with the allowable, indicate that the expansion loop may not have been necessary and that it would be desirable to shorten the expansion loop and make another calculation. To illustrate what might have been done, five alternate arrangements were studied. Normally these five additional conditions would have involved a tremendous amount of work but a new tool was used to obtain the answers.

Solutions by Punched Cards

One way of obtaining a thorough flexibility calculation during the early design stages is by the use of punched card tabulating machines or some other type of electronic computer.* So quickly are answers obtained by these machines that several calculations of one system are possible, thereby permitting a more efficient design resulting in substantial cost savings. The five alternate conditions mentioned were performed on a punched card calculating machine for the piping system shown in Fig. 1. The five runs, together with their condition and maximum calculated stress, are shown in **Table 2.** Note that by this series of calculations, an 80 ft expansion loop of forged and bored piping could have been eliminated. The total time for these five calculations was approximately three days.

Flexibility of Line

Another example of cost savings that can be realized by a quick, thorough calculation is the determination of the flexibility of a line to establish whether floating superheater headers are necessary. Usually the calculation of the flexibility of a line takes so much time that the type of superheater header designed must be specified long before any calculations have been completed.

One calculation recently performed with a punched card calculating machine on a main steam line showed that the piping system itself had adequate flexibility to relieve the bending stresses present without having to use the more expensive floating type header. This calculation was performed in approximately one day and saved the cost of the floating header as well as giving accurate data concerning reactions, stresses, and deflections at an early design stage.

A "byproduct" of a thorough calculation is a knowledge of pipe movements for hanger designs, points of minimum moment for purposes of cold spring and an accurate determination of end reactions on connecting pieces of equipment.

Hangers and Restraints

Because of unpredictable forces that may be present, it is considered good practice to install a system of restraints that will protect the smaller pipes on the end of this system from any mis-operation of the hangers. This is especially important since these smaller multibranched pipes at the ends of this system usually have the smallest section modulus and are at the end of the system where the moments are usually the greatest. Also the moment is not divided equally among these small leads. One type of restraint is shown in Fig. 2.

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*"The Solution of Pipe Expansion Problems by Punched-Card Machines" by L. H. Johnson, ASME Paper No. 53-F-23.

The horizontal tie rods on the turbine centerline force all the expansion to take place from the centerline, as is the natural case. In addition, the thermal expansion at point *P* may be as great as 7 or 8 in. horizontally and 12 to 14 in. vertically. If the hangers at point *P* offer any restriction to this movement, it can be expected that the expansion of the horizontal run of pipe will cause this lack of movement at *P* to be present at the stop valve *S*. It is therefore the purpose of the tie rods at *S* to force all the expansion from the centerline of the machine and insure that any mis-operation of the hangers in the long horizontal run will be taken out by the horizontal tie rods and not be reflected as a high bending stress in the smaller turbine leads.

Experience with a sliding guide instead of tie rods at *S* has shown that high friction forces may be present that will restrict the movement in the direction of the turbine centerline. This type of restraint is less desirable and tie rods with a minimum length of 6 ft should be used as a basis of good design.

Solid Rod Hanger

Another type of restraint commonly used is shown in Fig. 3. This solid rod hanger usually is installed at the turbine centerline and will protect the turbine leads from excessive downward thrusts and moments as well as pick up any errors in support of the entire system. It may not be possible to use this type of restraint in all cases since it may be desirable to take advantage of the flexibility of the horizontal length of pipe *S* to *P*. However, for cases where this horizontal length is relatively short or where there is adequate flexibility between point *P* and the boiler, this type of restraint has proven to be a very good protective device.

Since this point *P* may have large movements in the direction of the turbine centerline, any restrictions to movements it may impose will be forced back on the turbine leads. It is important that these solid rod hangers have adequate length so as to insure a free swinging point of support. Experience has shown that these rods should be 15 to 20 ft long, and close attention should be given to the pin ends to insure that this hanger will swing freely.

Checks of Piping Movements

The design of a piping system should continue through the erection of the piping in the field, with measurement checks to be sure the system is floating as planned. This is especially important with today's high alloy steels. Errors in erection and hanging of piping systems will be more critical than in the past since the high bending stresses present cannot relax, as was the case with the lower alloyed steels that had lower creep strength.

This conclusion was reached through experience in the field with installations that had failures of type 347 piping. Model tests and calculations were made that showed all stresses would be within the allowable if the system was free floating.

However, a measurement check of the movement of the piping systems together with actual force deflection tests made showed that forces were many times greater than those expected. A further breakdown of these high forces showed that for these cases they were due to weight components on too short hanger rods and also friction in the pin ends preventing the system from freely floating as planned. It seems reasonable to assume that these high restrictive forces were present on many low alloy systems that have been installed in the past and that the relatively low creep strength of the material has enabled these high forces to relax and prevent rupture.

The possibilities of failures and forced outages will be reduced if these recommendations are followed.

This paper was given at the semi-annual meeting of the American Society of Mechanical Engineers which was held this year in Pittsburgh.

New High Yearly Records Of Construction Set

NEW HIGH RECORDS were set by September's totals of contracts for future construction in the 37 states east of the Rockies, according to the F. W. Dodge Corp. The September total of $1,816,232,000 rounded out the biggest nine month total in Dodge's 63 yr history — $14,477,181,000. This was 13 percent ahead of the first nine months of 1953, which until now was the all time high.

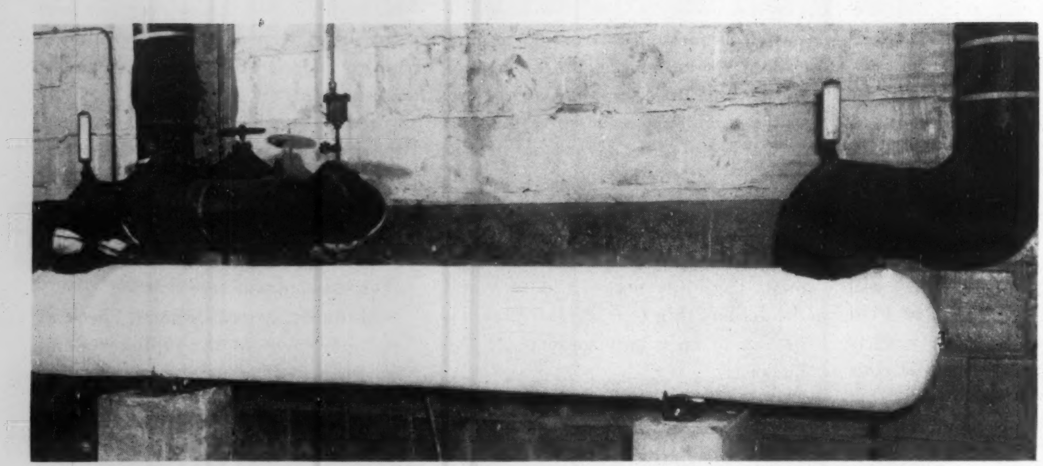
September's total was 4 percent above that of September 1953 and set an all time high for the month. Eliminating last year's atomic energy contracts of September, it was 20 percent ahead of September 1953.

"The significant fact," states Thomas S. Holden, vice chairman of the Dodge Corp., "is that the vast body of home builders and corporation executives and others who signed contracts in September affirmed in hard cash their faith in continuing prosperity in the months ahead.

"These figures bring almost mathematical assurance that new high yearly records will be set in 1954, both by the Dodge totals and by the government estimates of construction put in place."

Nine month categories compared with the same period 1953 were: nonresidential, $5,246,897,000, up 4 percent; residential, $6,196,199,000, up 26 percent; heavy engineering, $3,034,085,000, up 5 percent.

September categories were: nonresidential, $646,825,000, up 17 percent over August but 17 percent less than September 1935; residential, $777,332,000, up 12 percent over August and 53 percent over September 1953; heavy engineering, $392,075,000, up 19 percent over August but 13 percent below September 1953.



1 HEAT EXCHANGER, supplied by branch lines of brine system, is in the basement. Note thermometers and regulating valve

Piped Brine Cools Message Center

Zero degree brine is used to provide economical and trouble-free air conditioning in this pushbutton communication center.

By F. Griffith

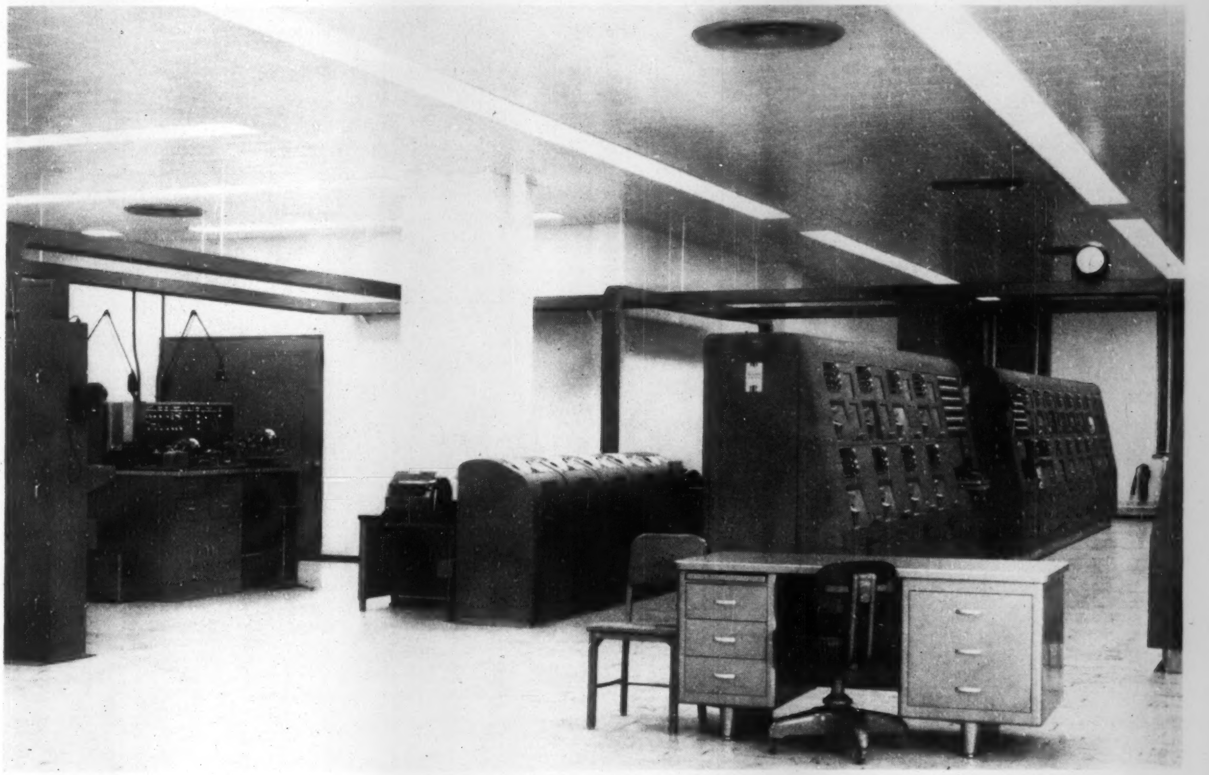
Air Conditioning Engineer, Western Union Co.

THE DESIGN of an air conditioning system for installation in buildings constructed years ago, when air conditioning was only a dream, presents numerous problems for the engineer. Floor space in crowded city buildings is at a premium, water conservation devices are a "must," and it is sometimes difficult to find a convenient roof or building offset on which to install a cooling tower or evaporative condenser.

One way to air condition a building is by using chilled water distributed through a piping system connected to individual air handling units on the various floors. The chilled water refrigerating plant has to be installed either on one of the upper floors, in a roof penthouse, or in the basement.

The advantage of the upper floor or the roof penthouse is often in the initial savings in piping between the refrigerating plant and cooling tower on the roof. Operating savings would also be realized because of the short distance necessary to pump the water between the condenser and the cooling tower. However, to install the equipment on an upper floor or in a roof penthouse would be economically undesirable because of the value of such space for offices. Construction of a penthouse especially for this purpose might be costly.

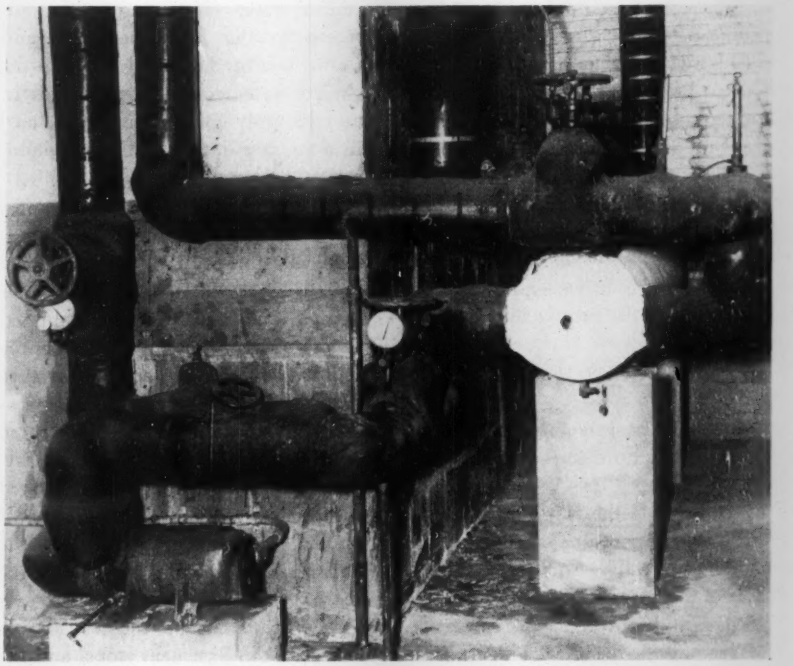
Locating the refrigerating plant in the basement would be advan-



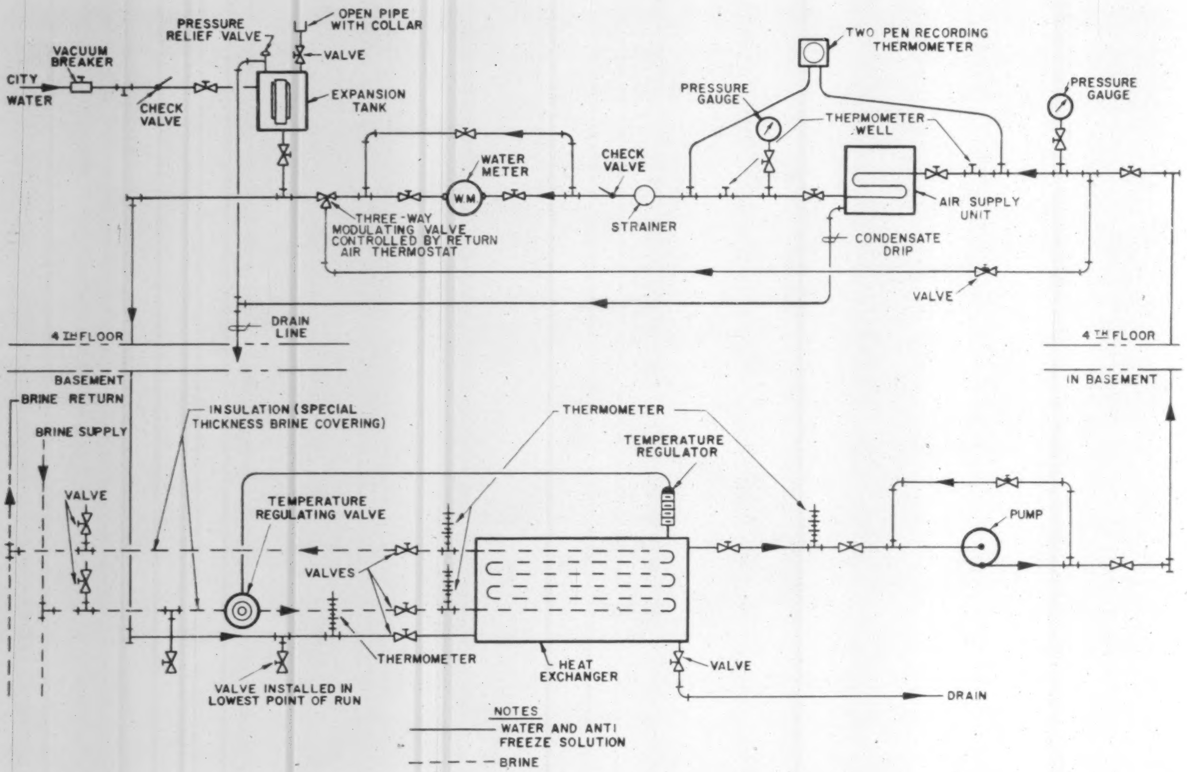
2 OUTDOOR AIR supply duct in the message center houses a wet bulb controller as an integral unit in the system

tageous since it would then be with other mechanical building equipment and convenient for the building engineers. However, the disadvantage of a considerable distance between the cooling tower on the roof and the plant in the basement is a factor.

Western Union engineers have solved these problems in the design of a system to air condition the modern nerve center of a nationwide communication system operated by Western Union for one of its patrons. The air conditioning system uses brine supplied by Merchants Refrigerating Co., which has pumped brine to cold storage warehouses in downtown New York for many years.



3 CIRCULATING PUMP, left, pumps chilled water to cooling coil of air unit on the fourth floor


PRESSURE RELIEF VALVE
OPEN PIPE WITH COLLAR
VALVE
VACUUM BREAKER
CITY WATER
CHECK VALVE
EXPANSION TANK
TWO PEN RECORDING THERMOMETER
PRESSURE GAUGE
THERMOMETER WELL
PRESSURE GAUGE
WATER METER
W.M.
CHECK VALVE
THREE-WAY MODULATING VALVE CONTROLLED BY RETURN AIR THERMOSTAT
STRAINER
AIR SUPPLY UNIT
CONDENSATE DRIP
VALVE
DRAIN LINE
4TH FLOOR
BASEMENT
4TH FLOOR
IN BASEMENT
BRINE RETURN
BRINE SUPPLY
INSULATION (SPECIAL THICKNESS BRINE COVERING)
THERMOMETER
TEMPERATURE REGULATOR
VALVE
TEMPERATURE REGULATING VALVE
PUMP
VALVES
THERMOMETER
HEAT EXCHANGER
VALVE
DRAIN
VALVE INSTALLED IN LOWEST POINT OF RUN
NOTES
WATER AND ANTI FREEZE SOLUTION
BRINE

4 FLOW OF BRINE — dotted line — through coils is controlled by temperature regulator and valve. Chilled water is pumped to coil of air unit

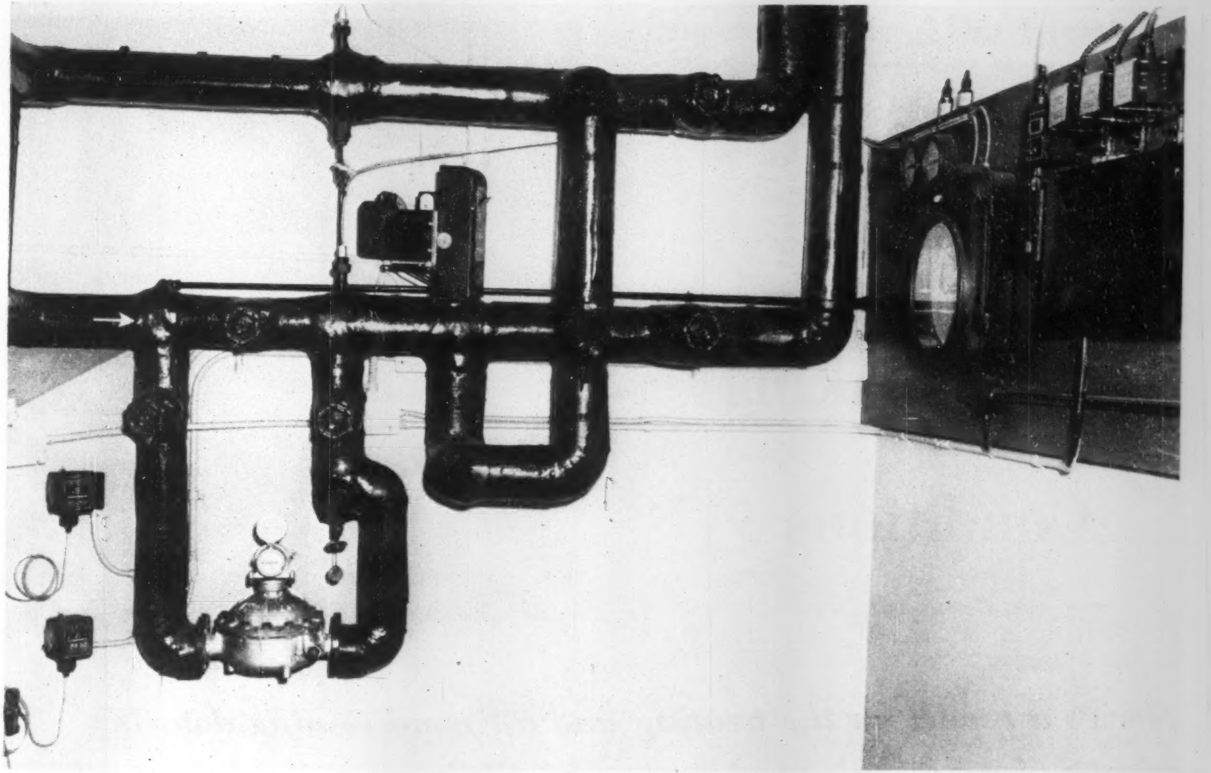
A branch of the underground brine piping system conveniently runs through the basement of the Western Union building, rather than under adjacent streets. These brine lines were tapped and branch lines run to a heat exchanger, which was installed in the basement as shown in Fig. 1. In the schematic drawing of the system — Fig. 4 — the heavy dashed lines show the brine supply and return lines to the heat exchanger.

Operation, Control Explained

In the heat exchanger, the brine flows through the coils and chills the water to 40 F. This is accomplished by controlling the rate of brine flow with a temperature regulator and modulating valve, shown in Fig. 4. The chilled water is treated with an antifreeze to prevent the formation of ice on the heat exchanger brine coils, and also to prevent a possible freeze-up in the exchanger itself. A chilled water circulating pump, adjacent to the heat exchanger and shown in Fig. 3, is used to pump the chilled water to the cooling coil of an air supply unit on the fourth floor, in a room adjacent to the communication center.

When the thermostat in the return air duct of the air conditioning system calls for cooling, a relay is actuated which starts the chilled water pump. Cold water is then supplied to the cooling coil in the air supply unit and the supply air temperature is lowered. As the room air temperature in the air conditioned room approaches the control point, a bypass valve modulates to the open position to reduce the quantity of chilled water passing through the cooling coil (see Fig. 4). When the thermostat is satisfied, the bypass valve opens wide, the circulating pump in the basement stops, and the supply of chilled water to the cooling coil is shut off.

The air conditioned space contains many small motors and other electrical heat generating equipment which contribute to the sensible heat load in the room. These factors make it desirable to cool the space when outdoor temperatures are approximately 60 F or above. Outdoor air — 100 percent — or a mixture of outdoor air and recirculated air may be supplied to the space when outdoor temperatures are sufficiently low and when the total heat in the outdoor air is less than the total heat in the recirculated air from the air conditioned room. One of the advantages of this type of air conditioning system is that all the necessary cooling can be provided by circulating outdoor air during cool weather, while chilled water is available if additional cooling is required. The flexibility of this system, which permits the use of either outdoor or recirculated room air, or any mixture, permits maximum efficiency.



5 **WATER METER** measures the quantity of chilled water passing through the cooling coil of the air conditioning system

The control system is centered around a wet bulb controller in the outdoor air supply duct. This controller, together with the return air thermostat in the recirculated air duct, causes the outdoor air damper, recirculated air damper, and the chilled water valve to modulate as required, to supply air of the proper temperature to maintain room conditions. This system operates automatically regardless of the season.

Bills are rendered monthly in accordance with the number of ton-days of refrigeration used. A ton-day of refrigeration is defined as the amount of refrigeration necessary to remove 12,000 Btu per hr for a period of 24 hr. A rate for a ton-day of refrigeration was agreed upon before the installation of the system, and this rate was used in a study to determine if it would be more economical to own and operate the refrigerating plant or to buy brine.

A system of measuring the number of ton-days of refrigeration was also agreed upon. This is accomplished by the use of a water meter which measures the quantity of chilled water passing through the air conditioning system cooling coil, together with a two pen, temperature recording meter, with 24 hr charts, which simultaneously measures the temperature of the water entering and leaving the cooling coil (Fig. 5).

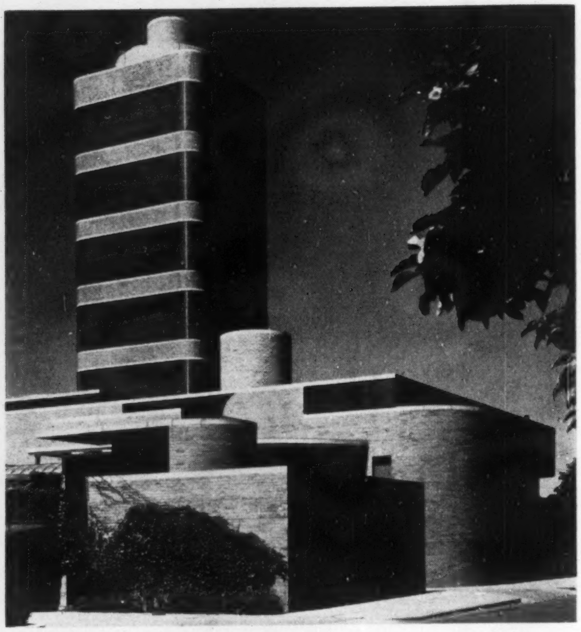
The recording meter electric clock mechanism is so connected that it operates the meter only when the circulating pump is operating. Recording meter charts are changed once for every 24 hr of pump operation and the water meter reading is recorded. With the use of a planimeter the average temperatures of the water entering and leaving the cooling coils can be determined and the difference calculated. With this average difference in water temperature, and the number of gallons of water pumped through the coils in 24 hr of pump operation, the number of ton-days can be calculated.

The system has given satisfactory and trouble-free service ever since it was installed in the spring of 1950. Maintenance cost has been low. The only moving parts of the entire plant are the water pump in the basement and the fan in the air handling unit. At the time of installation, a heat exchanger with excess capacity was installed, with liberally sized piping, to provide for a possible increase in the air conditioning load.

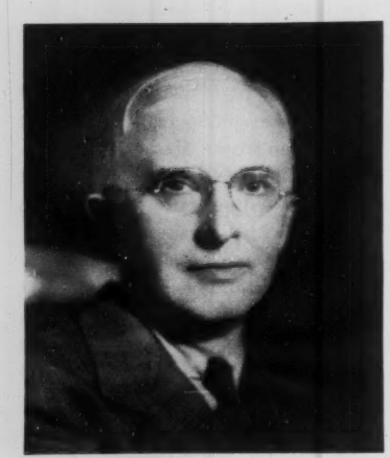
Comparison of the annual charges and operating cost of the existing equipment using brine, versus a system with a separate refrigerating plant owned by Western Union, reveals that the yearly total cost of the brine plant is a little less than the estimated yearly cost of a separate system. Moreover, no valuable space has been used, and a reliable system requiring the minimum amount of maintenance has been achieved.

SAM LEWIS' PAGE

Controlling Wax Making Conditions



Here's a report on the heating and air conditioning details of two of America's most unusual buildings . . . the Johnson Wax tower and the administration building, both designed by Frank Lloyd Wright



SAMUEL R. LEWIS, consulting mechanical engineer and a member of HPAC's board of consulting and contributing editors, comments informally each month on practical heating, piping and air conditioning problems.

S. C. Johnson & Son, Inc., of Racine, Wis., processes wax. A principal raw material is a wax from tropical trees, not particularly recommended for human food. This is different from the other kind of wax which we eat and enjoy that the honey bees gather from the nectar sacs in flowers.

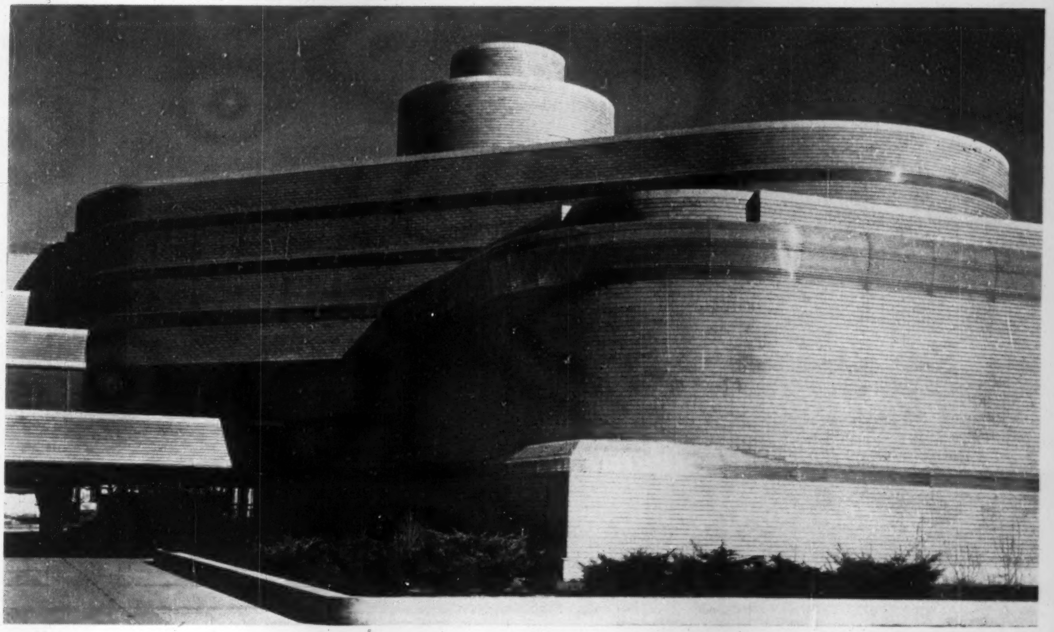
The Johnson waxes — fine for furniture, floors, and for enhancing automobile paint — have emerged from a historical background of paint and varnish. They are especially valuable as they reinforce and lengthen the life of varnishes.

For many years it has been our personal pleasure to serve the Johnson Co. in the way of heating, cooling, lighting and steam producing. The administration building designed by Frank Lloyd Wright bears his special individuality. It has no operating windows but depends exclusively on mechanical ventilation. Solar illumination is secondary, or auxiliary, to electric illumination.

Panel Heated Floors

Heating of the main story is accomplished largely by pipe coils suspended close to, but below the masonry floor. These pipes are heated by gently warmed water, the maximum temperature of which is never permitted to exceed 85 F.

A relatively small amount of exposed radiation extends around the perimeter walls below the unique Wright glass solar lights. These are round glass tubes laid horizontally one above the other all the way around the outside walls. The number and diameter of tubes vary, as does the size of the room, but



the continuous strip of windows thus obtained averages 2 ft in height.

Heat transmission across the glass area of course is resisted by the two curved thicknesses of glass and by the noncirculating air within each tube. The tube ends are sealed watertight to each other. Where the perimeter of one horizontal tube touches the outsides of the tubes above and below it, a special elastic non-hardening cement is employed, similar to putty at the edges of conventional flat glass panes. There may be some occasional leakage of windblown rain between the tubes where the seal has failed, but this has not proved unacceptable.

The administration building, serving over 500 employees, has a complete heating and ventilating and cooling system using mechanically circulated air that may, and frequently does, function independently of the panel heated floors. Completely automatic temperature control is provided throughout. The air supply is cleaned by electrostatic precipitators.

Cooling and Ventilating

Water, chilled by a centrifugal refrigerating machine, is used to remove the surplus heat in warm weather.

In maintaining year 'round comfort in both offices and the laboratory, free use is made of reheating the cool saturated air, with steam. This method of obtaining exact control of the relative humidity is especially justifiable in buildings that have many rooms of different orientation and heat reception.

An auxiliary to the original office building, including the research department, is housed in the 14 story, completely air conditioned tower.

There are seven rectangular stories in this tower, each having a balcony-like circular mezzanine story. Thus, a 14 story building at first glance appears to be a seven story building. The floors all are cantilevered from a central reinforced concrete core, each rectangular story supporting its own band of exterior masonry and horizontal glass tubes. These tubes follow the same unusual type of assembly as in the administration building.

On each story there is highly specialized laboratory equipment, such as sinks, benches, furnaces and hoods, all served by steam, gas, water, compressed air and electricity. All the pipes and ducts are enclosed in the central concrete supporting core, which resembles the stem of a mushroom. This core also encloses an elevator, a stairway and a toilet room on every story, along with the air ducts for complete air conditioning, and the chemical fume exhaust ducts.

At the base of the tower and extending for some distance from it, there are many insulated constant temperature compartments, each with its individual refrigerating system, for testing products at varying weather conditions.

Steam and water come across the street to the administration and research center through a walk-through tunnel, which is well lighted and ventilated.

The factory proper occupies a large area across several streets adjacent to the tower, and a new separate storage warehouse in a suburb of Racine has just been completed.

Steam for heating and processing is provided from three large stoker fired water tube boilers. All coal and ash handling is mechanical.

I was permitted to assist the following members of my staff on the Johnson work: R. W. Shields on refrigeration; S. I. Rottmayer on boiler plant; and Michael Feron on electric wiring and lighting, all in cooperation with Mr. Wright and the efficient Johnson organization.

How to Plan Air Conditioning for

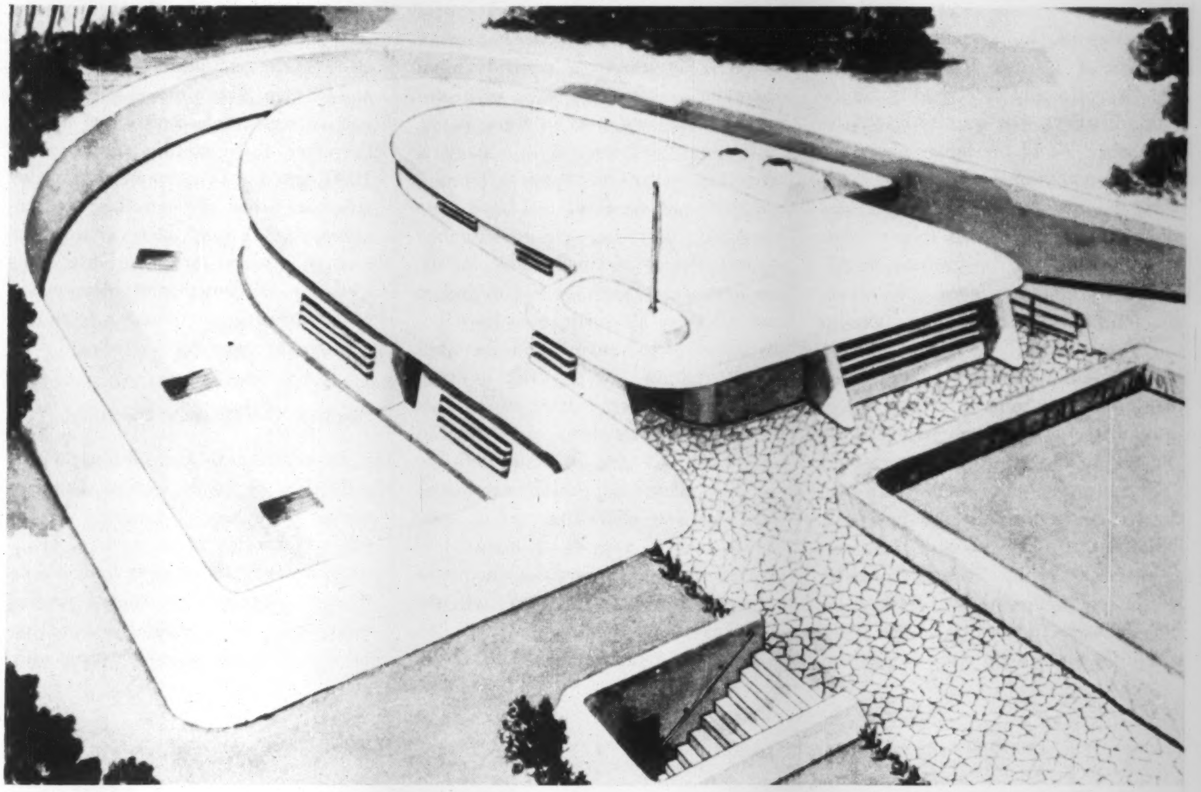
•Here's the first complete information available on how to plan for protection against atomic blast, chemical, biological and radiological agents. Details for specifying and assembling the component parts of the system are given along with results that may be expected.

Military and political conditions existing today and the development of technological warfare make it mandatory that collective protection be provided for military nerve centers, key industrial processes and personnel and for general public protection.

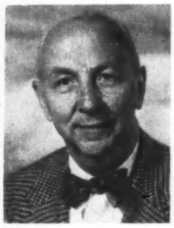
Shelters for chemical, biological and radiological protection are of two general types, ventilated and closed, and may be located above or below ground. The ventilated shelter provides purified outdoor air for pressurization of the shelter against infiltration of agents, and to supply oxygen, remove carbon dioxide, odors, heat and humidity to avoid vitiation of the internal atmosphere.

The closed type of shelter is more limited in respect to occupancy. For short occupancy, the internal atmosphere is permitted to become vitiated. For longer occupancy, and to keep carbon dioxide concentration below 3 percent, means are provided to supply or generate oxygen and to remove humidity, odors and carbon dioxide. In this article, design data is provided for shelter occupancy and air conditioning or purification.

Protective Shelters



SHELTERS should be designed for protection against any one or any combination of various elements of attack such as blast, chemical, biological and radiological agents



By Warren Viessman
Chemical Corps, U. S. Army

When primitive man and beast sought the protection of a cave against the natural environment — heat, cold, rain, snow and wind — and as a protection against an enemy, the primary purpose of shelter was established. Scientific, economic and political developments of our civilization today have not removed the necessity of caverns and buildings as shelters. On the contrary, their use has been intensified.

Early man was not particularly concerned about air conditioning, as the cave or hut he occupied was normally provided with natural ventilation, of a purity and at a temperature and humidity to which he was accustomed and which he considered adequate.

Environmental Protection

Today, in addition to providing protection against the natural environment, protective shelters should also provide protection against the weapons of an enemy. The purpose, location and terrain will have a bearing on the type and extent of the protection desired.

If the shelter is likely to be subjected to shell fire or bombing, a blast-resistant shelter of reinforced concrete or an underground cavern would probably be selected.

If a chemical attack is probable, protection against solid and liquid particulates and persistent and nonpersistent gases and vapors would be required.[9]

An attack by radioactive aerosols would require removal of those particulates before the air enters the shelter for ventilation or pressurization.

Similarly, if biological agents are used, the particulates must also be removed from the air before it enters the shelter or comes in contact with shelter personnel.

The particulates to be removed range from submicron sizes, such as those of tobacco smoke, of about 0.25 microns, up to pollens of 150 microns, a micron being 1/10,000 cm. Exceptionally fine quality filters and adsorbers are required to free the shelter air of the more important submicron contaminants.

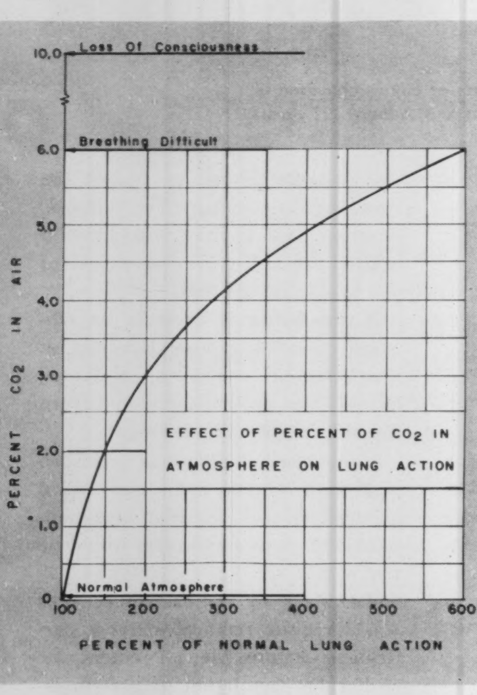
In the case of toxic dusts, fumes and mists, it is difficult to say what concentrations of the various chemicals may be considered safe. It is also not known what gases and vapors might be used by the enemy in time of war. Some war gases may produce threshold symptoms in the average individual for Ct values in excess of 2.0, where C is the concentration in milligrams per cubic meter and t is the exposure time in minutes. The lethal dose for 50 percent of persons at rest may be of the order of 100, while for personnel performing laborious tasks, it may be of the order of 25. Because of the high toxicity of some agents, and their low safe working level concentrations, practically no penetration can be permitted.

The concentration of bacteria creating a potential health hazard in a given environment depends upon the type of germ, the state of health of the individual, and on atmospheric and other conditions. Within shelters, airborne organisms varying from 1 to 1000 per cu ft of air have been reported. Many bacteria are attached to particles of dust present in the air. In some cases, perhaps one organism per 1000 cu ft of air may be a potential health hazard, and in other cases perhaps, 10 or 100, or even 1000 organisms per 1000 cu ft of air would be required to cause serious infection. Because bacteria multiply rapidly under favorable conditions and very low concentrations of some agents cause serious infection, removal of these particulates should be such that penetration through the filtering media is nil.

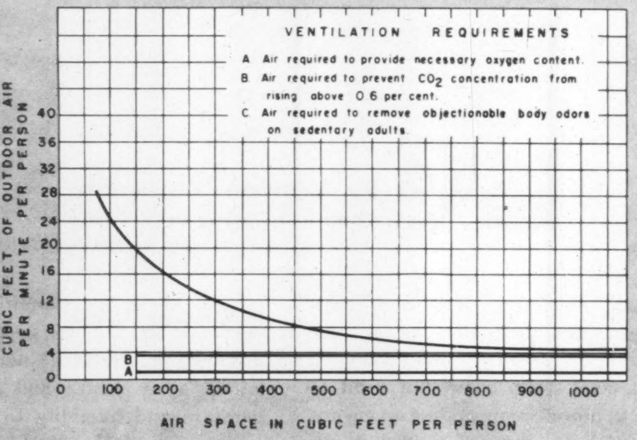
For air contaminated with radioactive particulates, the tolerance level for the more hazardous and common beta-gamma radio-isotopes such as iodine, strontium, and barium is considered to be 10,000 counts per minute for a sample collected from an electrostatic precipitator operating at 11.5 cfm. Therefore, it is a general rule to seek the protection of a shelter when the counting rate exceeds 1000 cpm and to evacuate an area or structure when the counting rate exceeds 10,000 cpm. Here again it is also necessary to have high air cleaning efficiency and elimination of radioactive particulates from the air stream entering a shelter.[24]

Shelter Occupancy Factors

In addition to the elimination or reduction of toxic agents within a shelter to a safe minimum, various other factors affect occupancy. These are primarily the oxygen and carbon dioxide content of the shelter air, the odor level, the temperature and humidity. The conditions existing with-



1 TESTS were conducted to study the physiological effects of varying concentrations of carbon dioxide in a controlled environment. Three percent is the practical limit for safe occupancy



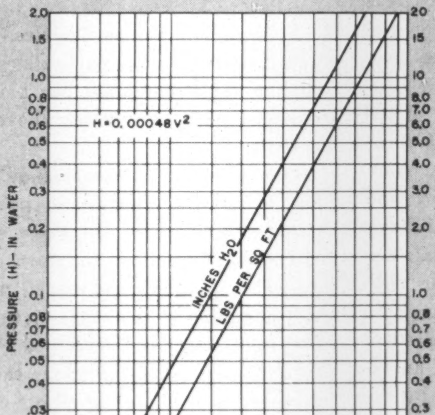
2 MORE AIR is required to remove objectionable body odors than for removing carbon dioxide and supplyin oxygen for sustaining life. The above chart indicate ample air supply under normal conditions in a shelter should be such as to permit normal duties to be performed, and to avoid nausea, panic, or loss of consciousness. Since an emergency condition exists when shelter occupancy is necessitated, usual comfort standards of ventilation and temperature are not necessarily maintained. One cfm of normal outdoor air will provide all the oxygen required per person for light duties, while nearly 4 cfm is required to keep the carbon dioxide content in a shelter down to within 0.6 percent, which is the maximum considered permissible for normal breathing.

As seen in Fig. 1, however, a carbon dioxide concentration of 1.5 percent only increases the lung action about 30 percent and is still quite innocuous.[23] Three percent carbon dioxide concentration increases lung action to twice normal and is the practical limit for safe occupancy. Four percent is physiologically undesirable. Tests conducted on personnel subjected to gradual buildup of carbon dioxide to 4 percent at the end of 22 hr showed the effects to be transitory.

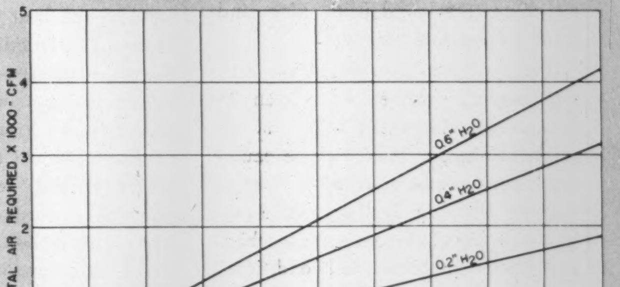
At the end of the period headaches were common, and a sense of chilliness was experienced by most of the persons at an effective temperature of 68 F. Breathing was difficult where exertion was required. Emotional reactions varied from increased irritability to excessive hilarity over minor incidents. The oxygen concentration was not recorded but probably dropped from a normal of 21 percent to 17 percent and may have been a contributing factor. Conditions were not maintained at 4 percent and were restored to normal after about 35 min. Five percent carbon dioxide is considered dangerous.

The air required to remove objectional body odors is, however, generally in excess of that required per person for oxygen supply and carbon dioxide removal. It is a function of the loading or space provided per person. This requirement is shown in Fig. 2. Shelter occupancy based on space and purified outdoor air ventilation requirements as shown on the *C* curve will generally be adequate to avoid vitiation and excessive discomfort due to odors, temperatures and humidity.

The temperature and humidity conditions will be affected by the heat transfer or insulation properties of the shelter,[7] the outdoor air,[8] or air and ground temperatures, the latent and sensible heat generated by the occupants for their degree of activity[11,18] and other contributing light, heat and power loads. As a practical limit of occupancy in order to avoid undesirable physiological effects, the shelter should be considered fully occupied when the effective temperature reaches 85 F. This is equivalent to 85 DB, 85 WB at an air velocity of 20 fpm, or 90 DB and 82 WB at the same air velocity. Underground shelters with capacity occupancy and normal services in operation usually require cooling rather than heating for both summer and winter in the temperate zone.[23] Air conditioning to control temperature and humidity



3 SUFFICIENT purified air must be provided to pressurize the building so that leakage is outward. Pressurization equivalent to overcome a wind velocity of 24 mph is suggested



4 TO ESTIMATE air requirements for pressurization of sealed shelters, consult above chart. Values should be decreased by one-third for tight concrete or steel underground shelters will be advantageous for many permanent and semi-permanent shelters.

Types of Shelters

From the air purification point of view, there are two types of shelters—pressurized ventilated shelters and closed unventilated shelters. Either of these types may be on the surface or underground, and of whatever construction is available or suitable. Entrance to either type of shelter during an attack should be through air locks and a decontamination chamber, where contaminated clothing can be removed, safely deposited, and clean clothing put on. Decontamination showers should be available.

For either pressurized or closed shelters above or underground, and whatever construction, all openings, air leakage around doors, windows and through wall cracks, must be sealed against entrance of toxic agents. For pressurized shelters above ground, the sealing should preferably be on the pressure side or on the inside. For other shelters, the sealing should be on the pressure side or on the accessible side. In general, sealing of good concrete and masonry construction, built-up roofs, plywood, cement-asbestos board and plaster board wall, is not warranted,[19] except at joints, cracks, defects, pipe and conduit penetrations, etc.

Various materials suitable for sealing protective shelters have been investigated, subjected to tests, and applications made. They include caulking compounds, adhesive tapes, sprayed webbing, and strippable materials. Some of these materials which are effective under normal conditions, at moderate cost, and which can be applied without skilled personnel, are given in Table 1. Applications should be made in accordance with the manufacturer's recommendations.

Pressurized Shelters

Where power is available, surface and underground shelters can be pressurized with blowers furnishing purified air from the atmosphere through filters. This type of installation protects against leakage through minute cracks or openings, provides purified outdoor air for occupants, and is desirable where entrance air locks are to be provided for access during an attack. In this latter case, air lock pressures are reduced below normal shelter pressure, and some air discharge, about 300 or 400 cfm, is provided through the air lock for scavenging purposes.[24]

When pressurization is employed for blast or bomb shelters, special provision must be made to close all air intakes to the shelter during blast to protect against direct contamination through ruptured ductwork, or by punctured filter media. Either (1) anti-backdraft valves or blast closures designed to withstand the blast should be provided on the air inlets, or (2) the inlet ductwork should be provided with perforated resistance plates or baffles arranged in labyrinth, or (3) air should be taken in through a gravel bed protected by barriers.

The air required is that necessary to avoid vitiation, which is a function of the cubic space per person, the working level of the personnel, whether at rest, light work, etc., the air temperature and absolute humidity inside and outside the shelter,[10] the air motion within the shelter and the heat conductivity of the shelter construction. Some of these factors, such as working level, population, and outside temperature and humidity are transient and difficult to determine. In the temperate zone, under normal conditions, air supplied in accordance with curve *C*, Fig. 2, will be ample. A practical check on occupant capacity of an existing shelter could be made by determination of carbon dioxide concentration, along with wet and dry bulb temperatures. The temperatures can be readily ascertained without expensive equipment and the effective temperature determined. The effective temperature should not exceed 85 F under most conditions.

In addition to supplying the necessary air to avoid vitiation, sufficient purified air must be provided to pressurize the building so that leakage through cracks and openings is outward. It is not probable that an effective attack would be launched when the wind velocity is greater than 12 mph, due to dispersion of the agent. Momentary gusts during the period might double this velocity, so a pressurization equivalent to a 24 mph wind would be desirable. This velocity is equivalent to a pressure of less than 0.3 in. of water gage, as shown in Fig. 3.

Because of the various stuctural materials and methods used for surface and underground shelters, and the variations in airtight integrity, it is difficult to estimate pressurization air requirements. Test information is still somewhat meager. The data given in Fig. 4, prepared from available test data on shelters of various constructions and sizes, will be found helpful in estimating the pressurization requirements.

The actual air supplied should be that necessary to meet the estimated pressurization air requirements or the vitiation air requirements, whichever is greater.

Particulate Removal

Solid and liquid particulates, bacteria, and radioactive particulates, including submicron sizes, can now be removed with efficiencies above 99 percent.

One means of accomplishing this has been with electrostatic precipitators. Special two and three stage viscous oil coated precipitators, composed of standard commercial parts, and operating at potentials up to 14,000 volts, have been developed.[5,25] In these special units, particular care is taken relative to sealing all air channels that might cause bypassing of the ionizers and cathode plates.

A dry type impingement filter, shown in Fig. 5, sometimes referred to as the Atomic Energy Commission or the Chemical Corps (Chemical Warfare Service) filter, has been developed and placed on the market.[16,22] This filter, having an efficiency of about 99.95 percent based on a 0.3 micron particle size, permits a penetration of 0.05 percent or less.

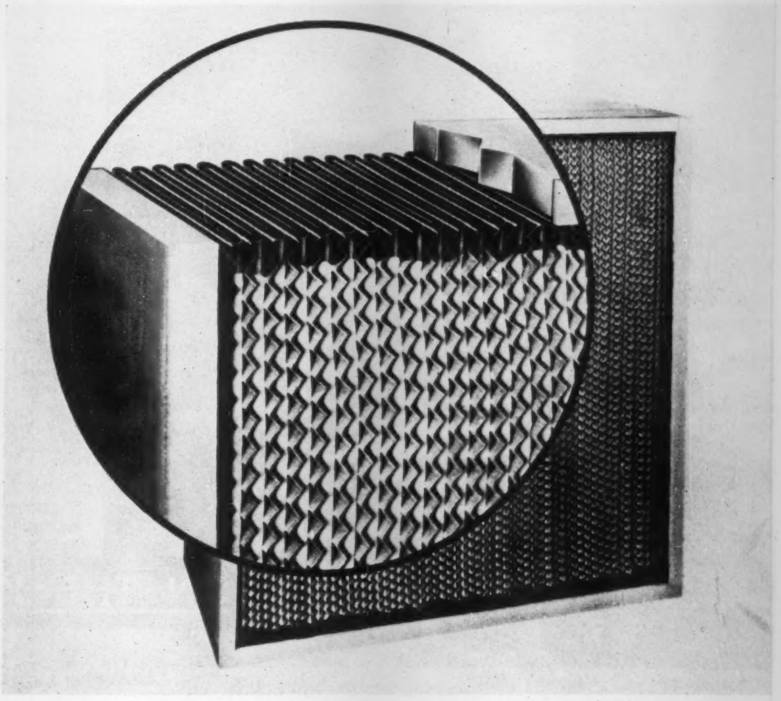
It is made up of accordion pleated, water resistant asbestos fiber paper, and will withstand operating temperatures up to 220 F. A 24 in. x 24 in. x 11½ in. filter has a rating of 1000 cfm at a pressure loss of about 1 in. WG. The dust holding capacity of this filter is high and it will operate for months on normal atmospheric dust before requiring replacement.

A glass fiber filter paper has been developed[3,4] giving efficiencies up to 99,999 percent with a lower pressure drop, but is not yet commercially available. Sand beds have also been effectively used for the removal of toxic aerosol agents.

High efficiency filters must be mounted in absolutely tight frames so that the air stream cannot bypass the filter.[25]

It is preferable with either the electronic precipitator or the absolute paper filter to provide a prefilter to remove the larger dust particles, lint, etc. The life or replacement cycle of the more expensive fine filters will thereby be increased. Either the wire crimped viscous oil coated[21] or the oil coated fiber glass type[2] prefilters would be advantageous.

The next article on this subject will discuss gas and vapor removal, atmospheric revitalization and other related phases.



5 CHEMICAL CORPS dry impingement type filter is rated to withstand temperatures up to 220 F and will operate for months on normal atmospheric dust before requiring replacement

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ON THE JOB

PIPEFITTER CHECKS electric pipe bender while 3 in. pipe to be used in hot water supply system is being bent. Pattern "table" for field welding connections in the prefabrication process is shown in foreground

BENDERS AND WELDERS hold one section of heating coil just after removing from pattern "tables" and before stacking in stockpiles for immediate use when needed

Prefabricated Field Piping Rushes

Floor Panel Heating for Schools

When floor panel heating was installed in three new Miller County, Ga., school buildings recently, field prefabrication and standardization of pipe saved both time and labor, according to the Jones and Laughlin Steel Corp.

The entire construction project, consisting of one story buildings, cost only $6.69 per sq ft. Over 14½ miles of standard weight special bending black steel pipe was used in the three projects.

Every coil was prefabricated according to a pattern, in an area slightly removed from busy construction points. The task included making all bends, field connecting and stockpiling for immediate availability.

All coils were made of 1 in. pipe, while mains varied from 2 to 3 in. in diameter according to the required capacity for the specified area. Spacings between coils vary from 12 to 18 in. in width; lengths are from 13½ to 18 ft. Straight grids in the supply and return systems are from 6 to 200 ft long.

Bent pipes to be used in coils were shoved directly on pattern "tables" for immediate welding connections. Size of coils was restricted to sizes easily handled by two men.

Immediately after grading was completed in each wing or section of the buildings, mains and coils were set in position. All were laid level and supported by concrete chair supports. Selection of this method of support was made by the engineer because of the guarantee of constant level and elimination of possibility of deterioration at position points.

Connections in the reverse return piping system installed were then made. Acetylene gas welding was used at all points possible in making connections to lessen chance of leaks or seepage. Eccentric welding reducers were used where pipes were reduced and stainless steel backing rings employed in all pipe joints of 2 in. and up.

Supply and return mains were laid near outside walls and in all hallways and corridors. Each serpentine panel in classrooms or other comparable areas being heated was equipped with a balancing cock in the heating coils, enabling each section to have equal and uniform heat as desired. Trapped air in the supply and returns is released through installation of air vent valve releases.

Since steel pipes enclosed in concrete expand at approximately the same rate as the jacket, the coil expansion is transmitted to the surrounding structural concrete. Pipes going through walls are sleeved and yarned with oakum.

The tops of the coils in their permanent location were positioned 2 in. under the top of the concrete floor. The pipes were thus completely embedded in concrete, limiting the possibility of leaks and guaranteeing the highest amount of heat transfer from the hot water to the panel.

Perimeter insulation was installed around the entire outside wall, using insulating blocks 1 in. thick and 1 ft. wide. As each section of the system was being covered in concrete, it was kept under a continuous hydrostatic pressure of 250 psi. The same pressure was applied to the entire closed circuit heating system after completion.

The heating system is controlled automatically and zoned for each wing or area. An outdoor thermostat anticipator mounted under the eaves of the building regulates the amount of heat transferred from the pipe coils inside, in case of sudden temperature changes.

The boiler is a package type unit with no stack. Light fuel oil will be used. All safety features have been incorporated into the system, with a warning light flashing in the office of the school principal in case of improper functioning of the boiler. An electronic safety attachment also cuts off the fuel supply to the boiler in case of a flame failure.

Heating contractors were Z. H. Williams Contractors and Equipment Co., and the architects were Albany Architects and Engineers.

Construction Volume To Continue

. . . in next six months

THE PRESENT RECORD volume of construction will continue during the next six months, with stable conditions prevailing in material prices and wages and increasing competition among contractors, indicates a national survey conducted in September by The Associated General Contractors of America.

The inquiries on prospects in the industry were directed to the 124 A.G.C. chapters throughout the U. S. and Alaska and the national directors of the association, representing approximately 6500 member firms which annually perform more than 80 per cent of the nation's total contract construction.

The predominant tone was one of optimism. This was supported by factual data concerning the factors involved in the survey.

Tabulated replies on the construction outlook show the following: Building: increase 43 percent; no change 37 percent; decrease 20 percent. Heavy: increase 42 percent; no change 34 percent; decrease 24 percent.

The confident outlook is significant since it follows a long period of rising construction activity. 1953 set an all time high of more than $50 billion of construction put in place, including $35.25 billion of new construction and approximately $15 billion of maintenance and repair expenditures. On the basis of the estimated seasonally adjusted annual rate of new construction for the first 8 months of this year, $36.5 billion, and the expectation that maintenance and repair expenditures will exceed $15 billion, the total volume for 1954 seems likely to approach $52 billion, the highest of all time.

One of the major reasons for the sustained high volume of construction this year, while business in general was dipping, and for expectations of a continuing high level during the next six months, as shown by the A.G.C. survey, consists of the big backlogs that have accumulated over a period of years.

Approve Average Wall Tube Thickness

. . . for vessels, heat exchangers

A RESOLUTION permitting the use of average wall thickness sizes of tubes in heat exchangers and other code vessels has been approved by the American Society of Mechanical Engineers, at the request of the Chemical Industry Advisory Board.

Previously, only minimum wall thickness sizes were permitted.

The text of the resolution is as follows: "Tubes of approved materials, no matter how specified as to thickness, may be used in code vessels, provided the permissible under tolerance does not reduce the thickness below that required by the applicable code for the pressure and temperature conditions of design."

Users of high alloy and nonferrous alloy tubes in the construction of heat exchangers and other code vessels may well hail the new rule. A cost saving of 10 percent is reported to be obtained through the use of an average wall instead of minimum wall thickness tubes.

N. Y. State Building Code To Expand Coverage

. . . effective next year

THE N. Y. STATE building construction code is now in force in 135 municipalities, totalling over a million population, according to the chairman of the code commission.

The code, whose local applicability is accepted voluntarily, applies to one and two family and multiple dwellings. Coverage for commercial, industrial, institutional and other nonresidential building is expected next year, the chairman says.

Don't Forfeit Your Right to Practice

WILLIAM HURD HILLYER, author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. A former vice president of the Atlanta Trust Co., his work there gave him a practical legal background.

THE RIGHT to practice engineering in the fields of heating and air conditioning, as in other fields, may be inadvertently forfeited unless the statutes conferring and regulating that right are strictly complied with. A "registered professional engineer" enjoys a tenure more subject to technical impairment by apparent trivialities than might be supposed—as one engineer recently discovered to his loss.

Payment for Services Withheld

Premiseze Improvement Co. retained A. B. Knowell under contract for his services as a professional engineer. (All names herein are fictitious.) Premiseze Improvement refused payment for Knowell's work on the ground that he was illegally practicing his profession. The engineer brought suit. Successful in the district court, but only partly so in the civil appeals court, he carried the case to the supreme court of the state.

An agreed statement by parties to the suit had established that (a) the services of Knowell, contracted for and rendered, constituted the practice of professional engineering as defined by statute; (b) he was duly registered as a "professional engineer" by the proper state board, which had issued to him a certificate of registration; (c) Knowell's certificate had not been revoked, (d) the contract sued on was made and the services rendered during a period wherein the engineer had failed to pay his annual certificate fee of $5 as required by statute.

It was further mutually conceded that the trial court's judgment for $5250 should be affirmed or reversed, according to whether the renewal of the engineer's certificate was or was not "a condition precedent" to the defendant company's liability.

The supreme court set forth this primary question: Is an engineer in possession of an original certificate, under the statute regulating the practice of professional engineering, illegally practicing when he renders engineering services during a year wherein he has failed to pay his annual certificate renewal fee as required by law?

Clearly, Knowell's fate hinged upon the legality of his practice under the circumstances, because as the supreme court saw it, if he was not lawfully practicing his profession "he is, and seems admittedly to be, barred from recovery." The declared purpose of the statute is "to safeguard life, health and property" from dangers arising through the unlawful practice of engineering. Such purpose being obviously important in the light of cited decisions, the court concluded that a contract for engineering services to be rendered by a person, prohibited under the statute from rendering them, was unenforceable.

Practice Was Illegal

After reviewing at length the law respecting issuance and renewal of certificates for registered professional engineers, the court reasoned as follows:

"It cannot be denied that . . . the original licensing of an engineer is one thing and the annual renewal certificate quite another." Under the statute the issuance of a certificate of registration is "evidence" that the holder "is entitled to all rights and privileges of a professional engineer . . . The certificate itself is identified with the right to practice." Therefore, the court declared, "practice by one whose certificate has been revoked for 'gross negligence, incompetency or misconduct' . . . would be unlawful, because the whole purpose of the statute" is to protect the public health and property from these very hazards.

While Knowell's certificate had not been formally revoked, the court saw its lapse for non-renewal as equivalent to revocation. The high tribunal found grounds for its conclusions in the general purpose or spirit of the statute as well as in its mere letter. A definite object of the renewal obligation is to supply an important part of the revenues "on which the whole operation of the law depends and to keep an up-to-date record of practicing engineers. Unless there is some substantial penalty to compel compliance, the burden of supporting the board falls entirely on those who comply, while the others get the benefit of the law but evade its obligations."

The court found "equitable appeal" in "a construction that favors better enforcement of an act for the protection of life and health at an occasional loss to those who somehow fail to carry the almost insignificant burdens for maintaining their high profession."

Judgments of the lower courts were accordingly reformed or reversed by the supreme court. The hapless Knowell was denied recovery on his entire claim for services. The paltry five-spot, which he carelessly withheld, thus cost him more than $5000.

[Note: While this discussion applies to an actual case, it should be remembered that legal rules vary in different states.]

QUESTION OF THE MONTH

What's the "U" Value?

When Reflective and Mass Insulations are Combined

THE QUESTION, *How Can We Calculate the Overall Heat Transfer Coefficient for a Wall with a Combination of Mass and Reflective Types of Insulation?*, was published previously in HPAC and is repeated here for information along with some answers to the question that have been received from HPAC's readers. Other comments for publication will also be welcome.

"We have been confronted with the problem of calculating the overall heat transfer coefficient of a frame wall in which a combination of mass and reflective types of insulation is installed. In other words, when two unlike insulations are used in the same wall — reflective and mass — how are the two different coefficients used in the calculation to determine the overall heat transfer coefficient?"

FRANK E. PARSONS —

"Let's Refer to FHA Technical Circular 7"

HOW TO DETERMINE the overall heat transmission coefficient for a wall with a combination of bulk and reflective insulation may be confusing. I would like to refer to the Federal Housing Administration Technical Circular No. 7, "Calculation of Building Section Heat Transmission Coefficients" in answering this question.

In Appendix D will be found the method of calculating values for reflective materials having or facing various emissivities. To explain this further, aluminum foil is generally considered to have an emissivity of 0.05. Coated reflective surfaces usually range in emissivity between 0.16 and 0.40 Non-reflective surfaces are generally considered to have an emissivity of 0.9. The FHA circular states that the emissivity of the reflective material should be known for accurate calculations.

In addition, as will be noted from the graphs and calculations in this circular, the values differ with the outdoor design temperature. These are noted on page 40, for example, and show four different thermal resistances — for outdoor design temperatures of −20, 0, +20, and +40 F. These values are also for heat flow in one direction only. Reflective-surfaced air spaces have different values for other positions and direction of heat flow.

Probably the best way to work out this problem, assuming that it is a typical building construction would be to consider the values given on page 41 in the third illustration at the right which is for 2 in. flexible insulation and standard frame walls. First of all, it should be decided whether a vapor barrier or a permeable material is to be used. As aluminum foil is a good vapor barrier in itself, it should not be chosen if a permeable reflective surface is desired. In that case, the coated paper type product of a permeable nature should be used. The emissivity of aluminum foil would, however, be 0.05, whereas the emissivity of the coated paper would be about 0.20.

Let us assume that aluminum foil has been selected and that the 2 in. of flexible insulation has been installed to contact the sheathing side. This leaves the air space on the plaster side, which will have aluminum foil attached either to the insulation surface or to the back of the wallboard. In order to calculate the overall heat transmission coefficient, the total resistance to heat flow would be 11.45. By deducting the value of 0.91 for the air space, a resistance of 10.54 is the result. Assuming that the design temperature is zero F, the resistance of the reflective surface having an emissivity of 0.05 facing an air space with the design temperature of zero F is 2.15. By adding the 2.15 to the 10.54, the total resistance for the combination of reflective and bulk insulation would be 12.69 which corresponds to a *U* value of 0.08.

I would suggest that the U.S. Bureau of Standards be consulted for more recent values of air spaces faced by various emissivities. — FRANK E. PARSONS, Engineer.

- *YOU ARE INVITED to contribute a question for publication, or an answer to a published question. Please address your reply to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

READER ASKS —

"How Can We Prevent Radiator Stubs Breaking Off?"

"We are having trouble with radiator stubs breaking off radiators in a new store. The hot water heating system has been in operation for only a part of one heating season, and we feel certain that the trouble may be attributed to insufficient provisions for expansion in the piping.

"We would like to see if other HPAC readers have experienced similar problems and what corrective measures were applied.

"We would also like to know where provision for expansion in the piping should be made and how to do it."—M.A.

Solar Irradiation

southeast or southwest facing walls and windows — May to September

By R. F. Quan* and F. W. Hutchinson**

• How much will solar irradiation affect the cooling or heating load of a building at 4:00 p.m. on May 10th? You can find the answer simply by using these tables. With them, you can quickly find the angle of incidence and the irradiation rate for any wall facing in any direction from east through south to west, for every hour of every month.

HEATING AND AIR CONDITIONING engineers frequently need precise information on the rate at which solar energy will strike a given structure. This article provides solutions for southeast- or southwest-facing walls or windows in latitudes from 30 to 45 deg from May through September.

Angle of Incidence Simplified

In each of the tables the angle of incidence, *i*, is given as the number of degrees between the direction of the sun's rays and a normal to the surface. The cosine of this angle, given in one column of each table, is of great practical importance, since it is numerically equal to the fraction of the vertical wall area that would be operative if this area were projected on a plane normal to the sun's rays. Thus, the product I_o cos i, given in the last column of each table, is equal to the rate of direct solar irradiation per unit area of the vertical wall or window.

The irradiation rates given are for direct solar energy only, and do not include sky radiation. Existing data on sky radiation is fragmentary and generally incomplete. Such radiation is known to vary with the solar position, but the relationship is not well defined.

How to Find Solar Quantities

For problems involving the sizing of equipment to meet a given heating or cooling load, the interest of the designer will be primarily directed toward instantaneous values of the irradiation rate. In performance problems, however, he will be more concerned with the quantity of solar energy rather than with the rate.

The procedure to be followed in evaluating solar quantities is as follows. Select the proper table for known orientation, season, and latitude, and add the instantaneous irradiation rates for each hour of the month in question. Divide this total by the number of hours for which rates are given, thereby obtaining the average irradiation rate for the full day.

Now refer to the table and determine the maximum possible number of hours that irradiation could occur for the known orientation, latitude and month. Multiply the maximum hours by the average irradiation rate to obtain the quantity of irradiation that would be received by a unit area of the wall during clear weather for the day in question. This figure could then be corrected by using weather bureau data for the fraction of maximum possible sunshine which is to be expected at that particular locality.

To Evaluate Transmission or Absorption

Note that the tabular irradiation rates do not directly permit determination of the solar gain due to either transmission through a window or absorption by a wall. Both transmission and absorption are functions of the material in question and of the angle of incidence; they usually increase markedly as the angle of incidence decreases. When these values are known for the particular window or wall, they can be multiplied by the tabulated irradiation rates — at each angle of incidence — to obtain the actual rate or quantity of solar energy transmitted or absorbed.

MAXIMUM NUMBER of hours of irradiation

	Wall Facing		
	South	S.E. or S.W.	E. or W.
Latitude 30°			
May	7.8	8.6	6.8
June	6.1	8.9	7.2
July	7.6	8.9	7.2
August	10.1	9.0	6.9
September	12.6	9.1	6.4
Latitude 35°			
May	8.8	8.8	6.9
June	8.1	9.1	7.2
July	8.6	9.1	7.2
August	10.6	9.3	6.9
September	12.7	9.3	6.4
Latitude 40°			
May	9.6	9.2	6.9
June	9.0	9.4	7.2
July	9.4	9.5	7.2
August	11.4	9.5	6.9
September	12.8	9.5	6.4
Latitude 45°			
May	10.2	9.4	6.9
June	9.8	9.7	7.2
July	10.0	9.7	7.2
August	11.4	9.7	6.9
September	12.8	9.6	6.4

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*Associate Mechanical Engineer, California State Harbor Board.

**Professor of Mechanical Engineering, University of California.

TABLE 9a

Southeast or Southwest Wall — Latitude 30°

Solar Time	Solar Altitude H	Azimuth A	B= A−135	cos H	cos B	cos i	i	Normal Intensity I_o	I_o cos i
SE SW May									
6am, 6pm	10	73	−62	0.9848	0.4695	0.4624	62.45	107.5	49.71
7am, 5pm	22	79	−56	0.9272	0.5592	0.5185	58.76	207.2	105.85
8am, 4pm	36	86	−49	0.8090	0.6561	0.5308	57.93	252.2	133.87
9am, 3pm	48	93	−42	0.6691	0.7431	0.4972	60.19	273.4	135.93
10am, 2pm	61	103	−32	0.4848	0.8481	0.4116	65.70	285.5	117.51
11am, 1pm	73	123	−12	0.2924	0.9782	0.2860	73.38	291.3	83.31
12 Noon	80	180	45	0.1737	0.7071	0.1228	82.95	293.1	35.99
June									
6am, 6pm	13	70	−65	0.9744	0.4226	0.4118	65.68	149.9	61.73
7am, 5pm	31	79	−56	0.8572	0.5592	0.4793	61.36	237.9	114.02
8am, 4pm	37	82	−53	0.7986	0.6018	0.4806	61.28	254.6	122.36
9am, 3pm	51	89	−46	0.6293	0.6947	0.4372	64.03	276.9	121.06
10am, 2pm	63	97	−38	0.4540	0.7880	0.3577	69.03	286.7	102.55
11am, 1pm	76	114	−21	0.2419	0.9336	0.2258	76.95	292.2	65.98
12 Noon	84	180	45	0.1045	0.7071	0.0739	85.74	293.7	21.70
July									
6am, 6pm	10	72	−63	0.9848	0.4540	0.4471	63.44	107.5	48.06
7am, 5pm	22	78	−57	0.9272	0.5446	0.4209	65.10	207.2	87.21
8am, 4pm	36	85	−50	0.8090	0.6428	0.5200	58.67	252.2	131.14
9am, 3pm	48	92	−43	0.6691	0.7314	0.4894	60.70	273.4	133.80
10am, 2pm	61	102	−33	0.4848	0.8387	0.4066	66.00	285.5	160.84
11am, 1pm	73	120	−15	0.2924	0.9659	0.2824	73.60	291.3	82.26
12 Noon	80	180	45	0.1737	0.7071	0.1223	82.80	293.1	35.85
August (*-Values apply both to SE and SW walls)									
6am, 6pm	7	79	−56	0.9926	0.5592	0.5551	56.28	69.0	38.30
7am, 5pm	21	87	−48	0.9336	0.6691	0.6247	51.33	202.8	126.69
8am, 4pm	32	94	−41	0.8480	0.7547	0.6400	50.00	241.0	154.24
9am, 3pm	46	103	−32	0.6947	0.8481	0.5892	53.99	270.4	159.32
10am, 2pm	57	116	−19	0.5446	0.9455	0.5149	59.00	282.5	145.46
11am*, 1pm*	68	139	4	0.3746	0.9976	0.3737	68.05	289.4	108.15
12 Noon*	72	180	45	0.3090	0.7071	0.2185	77.37	290.7	63.52
September									
6am, 6pm	5	89	−46	0.9962	0.6947	0.6921	46.21	56.0	38.76
7am, 5pm	14	97	−38	0.9703	0.7880	0.7646	40.13	157.0	120.04
8am, 4pm	26	105	−30	0.8988	0.8660	0.7784	38.88	223.0	173.58
9am, 3pm	39	116	−19	0.7772	0.9455	0.7348	42.71	258.9	190.24
10am, 2pm	49	130	− 5	0.6561	0.9962	0.6536	49.21	274.6	179.48
11am*, 1pm*	58	151	16	0.5299	0.9913	0.5253	58.31	283.3	148.82
12 Noon*	61	180	45	0.4848	0.7071	0.3428	69.95	285.5	97.87

TABLE 10a

Southeast or Southwest Wall — Latitude 35°

Solar Time	Solar Altitude H	Azimuth A	B= A−135	cos H	cos B	cos i	i	Normal Intensity I_o	I_o cos i
SE SW May									
6am, 6pm	12	73	−62	0.9782	0.4695	0.4593	62.65	133.5	61.32
7am, 5pm	23	81	−54	0.9205	0.5878	0.5411	57.26	211.6	114.49
8am, 4pm	36	89	−46	0.8090	0.6947	0.5620	55.80	252.2	141.74
9am, 3pm	49	99	−36	0.6561	0.8090	0.5308	57.96	274.6	145.76
10am, 2pm	60	112	−23	0.5000	0.9205	0.4602	62.60	284.8	131.06
11am, 1pm	70	135	0	0.3420	1.0000	0.3420	69.00	290.2	99.25
12 Noon	75	180	45	0.2588	0.7071	0.1830	79.46	291.9	53.42
June									
6am, 6pm	14	71	−64	0.9703	0.4384	0.4254	64.82	157.0	66.79
7am, 5pm	26	78	−57	0.8988	0.5446	0.4895	60.70	223.0	109.16
8am, 4pm	38	86	−49	0.7880	0.6561	0.5170	58.87	256.7	132.71
9am, 3pm	51	95	−40	0.6293	0.7660	0.4820	61.19	276.9	133.47
10am, 2pm	63	107	−28	0.4540	0.8830	0.4009	66.37	286.7	114.94
11am, 1pm	73	129	− 6	0.2924	0.9945	0.2929	72.97	291.3	85.32
12 Noon	78	180	45	0.2079	0.7071	0.1470	81.55	292.7	43.03
July									
6am, 6pm	12	73	−62	0.9782	0.4695	0.4593	62.66	133.5	61.32
7am, 5pm	22	80	−55	0.9272	0.5736	0.5318	57.87	207.2	110.89
8am, 4pm	35	88	−47	0.8192	0.6820	0.5587	56.03	249.8	139.56
9am, 3pm	47	97	−38	0.6820	0.7880	0.5374	57.50	272.1	146.23
10am, 2pm	59	110	−25	0.5150	0.9063	0.4667	62.18	284.1	132.59
11am, 1pm	70	133	− 2	0.3420	0.9994	0.3418	63.77	290.2	99.19
12 Noon	76	180	45	0.2419	0.7071	0.1710	80.15	292.2	49.97
August (*-These values apply both to SE and SW walls)									
6am, 6pm	8	80	−55	0.9903	0.5736	0.5680	55.38	83.5	47.43
7am, 5pm	19	88	−47	0.9455	0.6820	0.6448	49.85	189.8	122.38
8am, 4pm	32	97	−38	0.7480	0.7880	0.6682	48.07	241.0	161.04
9am, 3pm	44	108	−27	0.7193	0.8910	0.6409	50.14	267.7	171.57
10am, 2pm	56	123	−12	0.5592	0.9782	0.5470	56.83	281.6	154.04
11am*, 1pm*	64	145	10	0.4384	0.9848	0.4317	64.42	287.2	123.98
12 Noon*	68	180	45	0.3746	0.7071	0.2649	74.14	289.3	76.63
September									
6am, 6pm	5	89	−46	0.9962	0.6947	0.6921	46.20	56.0	38.76
7am, 5pm	14	98	−37	0.9703	0.7986	0.7749	39.20	157.0	121.66
8am, 4pm	26	107	−28	0.8988	0.8830	0.7936	37.48	223.0	176.97
9am, 3pm	39	119	−16	0.7772	0.9613	0.7471	41.92	258.9	193.42
10am, 2pm	48	134	− 1	0.6691	0.9999	0.6690	48.00	273.4	182.90
11am*, 1pm*	55	154	19	0.5736	0.9455	0.5423	57.15	280.8	152.28
12 Noon*	58	180	45	0.5299	0.7071	0.3747	68.00	283.3	106.15

HPAC DATA SHEET

TABLE 11a

Southeast or Southwest Wall — Latitude 40°

Solar Time	Solar Altitude H	Azimuth A	B = A−135	cos H	cos B	cos i	i	Normal Intensity I_o	$I_o \cos i$
SE SW May	(*–These values apply both to SE and SW wall)								
6am, 6pm	13	74	−61	0.9744	0.4848	0.4724	61.81	148.9	70.81
7am, 5pm	23	83	−52	0.9205	0.6157	0.5667	55.47	211.6	119.91
8am, 4pm	35	93	−42	0.8192	0.7431	0.6087	52.50	249.8	152.05
9am, 3pm	47	104	−31	0.6820	0.8572	0.5846	54.23	272.1	159.07
10am, 2pm	57	119	−16	0.5446	0.9613	0.5235	58.43	282.5	147.89
11am*, 1pm*	66	143	8	0.4067	0.9903	0.4028	66.24	288.3	116.27
12 Noon*	70	180	45	0.3420	0.7071	0.2418	76.00	290.2	70.17
June									
6am, 6pm	15	72	−59	0.9659	0.5150	0.4974	60.18	165.2	82.17
7am, 5pm	27	81	−54	0.8910	0.5878	0.5237	58.42	226.5	118.62
8am, 4pm	38	90	−45	0.7880	0.7071	0.5572	56.13	256.7	143.03
9am, 3pm	50	100	−35	0.6428	0.8192	0.5266	58.22	275.8	145.24
10am, 2pm	61	115	−20	0.4848	0.9397	0.4557	62.89	285.5	130.10
11am*, 1pm*	69	139	4	0.3584	0.9976	0.3575	69.07	289.8	103.60
12 Noon*	74	180	45	0.2756	0.7071	0.1949	78.76	291.5	56.81
July									
6am, 6pm	13	74	−61	0.9744	0.4848	0.4724	61.81	149.9	70.81
7am, 5pm	24	82	−53	0.9136	0.6018	0.5498	56.65	215.0	118.21
8am, 4pm	36	92	−43	0.8090	0.7314	0.5917	53.70	252.2	149.23
9am, 3pm	47	103	−32	0.6820	0.8481	0.5784	54.67	272.1	157.38
10am, 2pm	58	118	−17	0.5299	0.9563	0.5067	59.55	283.3	143.55
11am*, 1pm*	67	142	7	0.3907	0.9926	0.3878	67.12	288.9	112.04
12 Noon*	71	180	45	0.3256	0.7071	0.2302	76.61	290.6	66.90
August									
6am, 6pm	9	81	−54	0.9877	0.5878	0.5806	54.55	98.0	56.90
7am, 5pm	20	90	−45	0.9397	0.7071	0.6645	48.35	196.3	130.44
8am, 4pm	31	100	−35	0.8572	0.8192	0.7022	45.40	237.9	167.05
9am, 3pm	42	112	−23	0.7431	0.9205	0.6840	46.84	264.4	180.85
10am, 2pm	52	128	− 7	0.6157	0.9926	0.6111	52.33	278.9	170.44
11am*, 1pm*	59	151	16	0.5150	0.9613	0.4951	60.32	284.1	140.66
12 Noon*	63	180	45	0.4540	0.7071	0.3210	71.22	286.7	92.03
September									
6am, 6pm	5	89	−46	0.9962	0.6947	0.6921	46.20	56.0	38.76
7am, 5pm	12	99	−36	0.9782	0.8090	0.7914	37.68	133.5	105.65
8am, 4pm	24	110	−25	0.9136	0.9063	0.8280	34.11	215.6	178.52
9am, 3pm	34	122	−13	0.8290	0.9744	0.8078	36.12	247.0	199.53
10am*, 2pm*	42	137	2	0.7431	0.9994	0.7427	42.03	264.5	196.44
11am*, 1pm*	49	157	22	0.6561	0.9272	0.6083	52.54	274.6	167.04
12 Noon*	51	180	45	0.6293	0.7071	0.4450	63.57	276.9	123.22

TABLE 12a

Southeast or Southwest Wall — Latitude 45°

Solar Time	Solar Altitude H	Azimuth A	B = A−135	cos H	cos B	cos i	i	Normal Intensity I_o	$I_o \cos i$
SE SW May	(*–These values apply both to SE and SW wall)								
6am, 6pm	14	76	−59	0.9703	0.5150	0.4997	60.02	157.0	78.45
7am, 5pm	25	86	−49	0.9063	0.6561	0.5946	53.51	219.6	130.57
8am, 4pm	35	96	−39	0.8192	0.7772	0.6367	50.45	249.8	159.05
9am, 3pm	45	109	−26	0.7071	0.8988	0.6355	50.55	269.3	171.14
10am, 2pm	55	125	−10	0.5736	0.9848	0.5649	55.60	280.8	158.62
11am*, 1pm*	62	149	14	0.4695	0.9703	0.4556	62.90	286.1	130.35
12 Noon*	65	180	45	0.4226	0.7071	0.2988	72.61	287.8	85.99
June									
6am, 6pm	16	73	−62	0.9613	0.4695	0.4513	63.16	172.1	77.67
7am, 5pm	27	83	−52	0.8910	0.6157	0.5486	56.72	226.5	124.26
8am, 4pm	38	94	−41	0.7880	0.7547	0.5343	57.70	256.7	137.15
9am, 3pm	48	106	−29	0.6691	0.8746	0.5852	54.18	273.4	159.99
10am, 2pm	58	122	−13	0.5299	0.9744	0.5163	58.91	283.3	146.27
11am*, 1pm*	65	146	11	0.4226	0.9816	0.4148	65.50	287.8	120.42
12 Noon*	69	180	45	0.3584	0.7071	0.2534	75.30	289.8	73.43
July									
6am, 6pm	14	75	−60	0.9703	0.5000	0.4852	60.97	157.0	76.18
7am, 5pm	25	85	−50	0.9063	0.6428	0.5826	54.36	219.6	127.94
8am, 4pm	35	95	−40	0.8192	0.7660	0.6275	51.13	249.8	156.75
9am, 3pm	46	108	−27	0.6947	0.8910	0.6190	51.76	270.4	167.38
10am, 2pm	54	124	−11	0.5878	0.9816	0.5770	54.76	279.9	161.50
11am*, 1pm*	63	148	13	0.4540	0.9744	0.4424	63.74	286.7	126.84
12 Noon*	66	180	45	0.4067	0.7071	0.2876	73.29	288.4	82.94
August									
6am, 6pm	9	81	−54	0.9877	0.5878	0.5806	54.50	98.0	56.90
7am, 5pm	20	92	−43	0.9397	0.7314	0.6873	46.58	196.3	134.92
8am, 4pm	30	103	−32	0.8660	0.8481	0.7345	42.68	235.1	172.68
9am, 3pm	40	116	−19	0.7660	0.9455	0.7243	43.59	260.4	188.61
10am, 2pm	49	133	− 2	0.6561	0.9994	0.6557	49.03	274.6	180.06
11am*, 1pm*	55	154	19	0.5736	0.9455	0.5194	58.70	280.8	145.85
12 Noon*	58	180	45	0.5299	0.7071	0.3747	68.00	283.3	106.15
September									
6am, 6pm	5	89	−46	0.9962	0.6947	0.6921	46.20	56.0	38.76
7am, 5pm	11	100	−35	0.9816	0.8192	0.8043	36.46	117.0	94.10
8am, 4pm	22	112	−23	0.9272	0.9205	0.8535	31.41	207.2	176.85
9am, 3pm	31	125	−10	0.8572	0.9848	0.8442	32.41	237.9	200.84
10am*, 2pm*	39	140	5	0.7772	0.9962	0.7742	39.27	258.9	200.44
11am*, 1pm*	44	159	14	0.7193	0.9703	0.6979	45.74	267.7	186.83
12 Noon*	46	180	45	0.6947	0.7071	0.4912	60.58	270.7	132.97

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

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Measurement of Angular Emissivity‡

By Aydin Umur*, G. V. Parmelee and L. F. Schutrum†, Cleveland, Ohio**

This paper is the result of research carried on by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS at its Research Laboratory located at 7218 Euclid Ave., Cleveland 3, Ohio

SUMMARY — The relationship between emissivity and angle of emission of paints, oxidized metals, and roofing asphalt has been studied with a radiometer having a narrow field of view. It was found that all surfaces showed substantially no change in emissivity for angles of emission between perpendicular to the surface and about 50 deg from perpendicular. For larger angles the surface emissivity decreased as the angle increased with the exception of oxidized copper. In this case, emissivity first increased as the angle increased and then decreased with further increases in the angle of emission. Except for the oxidized copper the hemispherical emissivity was found to be approximately 95 percent of the normal (perpendicular) emissivity. Details of the experimental procedures and the method of correcting for stray reflections are described.

IN PROBLEMS of heat transfer dealing with the exchange of heat radiation, it is a common practice to use the normal (perpendicular) emissivity values of the surfaces involved. It is assumed that the emissivity of a surface element is the same regardless of the direction of emission into the surrounding hemisphere and that it is numerically equal to the normal emissivity value. In most cases, this assumption is justifiable and gives sufficiently accurate results. However, it has been established from theory and verified by experiment that the emissivity of a surface element varies as the direction of emission departs from normal. Some problems of heat transfer, particularly those encountered in research work, require a knowledge of this variation of emissivity with angle. From a practical viewpoint it may be necessary to give consideration to the directional characteristics of radiant panels, such as small high temperature panels.

This paper describes apparatus for angular emissivity measurements and reports values obtained for a number of surfaces. Most of the surfaces were painted ones, because no previous data for such surfaces were available.

The investigation was initiated as part of the research carried on at the ASHVE Research Laboratory under Group B of the TAC on Panel Heating and Cooling□. Data were needed for the painted surface of the Environment Laboratory and for globe thermometer paints. Emissivity values were also needed for two other projects being carried on at the Laboratory.

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‡Based upon a thesis submitted by Aydin Umur to Case Institute of Technology in partial fulfillment of the requirements for his M.S. degree in Mechanical Engineering.

□Personnel—Group B: J. M. van Nieukerken, Chairman; C. O. Mackey, Vice Chairman; C. M. Ashley, W. P. Chapman, W. S. Harris, Linn Helander, E. S. Howarth, A. T. Jorn, C. F. Kayan, H. A. Lockhart, W. E. Long, R. L. Maher, R. A. Miller, D. L. Mills, G. L. Wiggs.

Apparatus

Essential features of the apparatus were: (1) a sensitive radiometer with its field of view restricted to a narrow cone angle (see Figs. 1 and 2), (2) calibration apparatus for the radiometer, (3) a means of heating the sample and holding it at the desired angles with respect to the line of sight of the radiometer, and (4) a means of controlling and evaluating the environment surrounding the sample so that full account could be taken of stray radiation. The radiometer was a commercial instrument to which modifications were made as described in Appendix A.

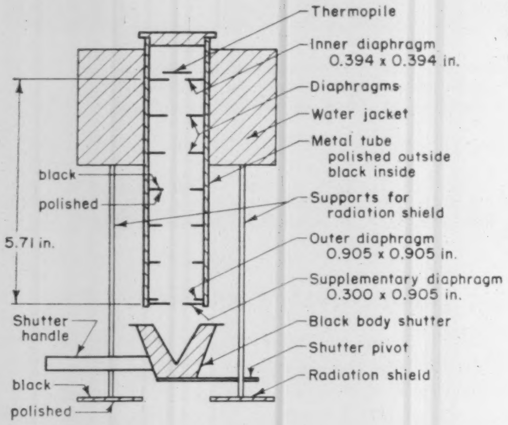
Thermopile
Inner diaphragm 0.394 x 0.394 in.
Diaphragms
Water jacket
Metal tube polished outside black inside
black
polished
Supports for radiation shield
5.71 in.
Outer diaphragm 0.905 x 0.905 in.
Supplementary diaphragm 0.300 x 0.905 in.
Shutter handle
Black body shutter
Shutter pivot
Radiation shield
black
polished

Fig. 1 — Schematic drawing of radiometer

Test Surface Preparation and Shielding: All test surfaces were prepared on flat metal plates 6 x 12 in. in size and from 1/16 to 1/8 in. in thickness. To measure the temperature of the test surface eight thermocouples were installed in grooves cut into the back surface of the plate. A heater unit was bonded to the back surface of this plate with a double-sided adhesive tape. It was covered with a ½-in. thick insulation board to avoid excessive heat loss to the surroundings and to insure uniform heating, which is an important factor, since the radiometer sighted a large area at high angles. The heater element was made from 0.002-in. thick constantan foil. It was designed for 24 volts and had a resistance of 5.73 ohms. A film type adhesive was used to bond a layer of anodized aluminum foil on each side of the element. Details of a similar bonding process have been previously described.[1] The heat input was sufficient to obtain sample temperatures up to 180 F and was regulated by means of an auto-transformer and a voltage stabilizer.

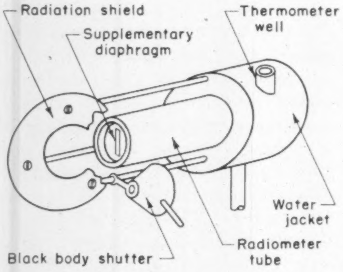
Radiation shield
Supplementary diaphragm
Thermometer well
Water jacket
Radiometer tube
Black body shutter

Fig. 2—External view of radiometer

To shield the sample from stray radiation, it was placed inside a cylindrical tank which was in turn placed inside a slightly larger rectangular tank (see Fig. 3). A pump circulated water in the space between the two tanks to maintain the cylinder at a uniform temperature. The sample was supported in the cylinder at the lower end of a vertical rod. The upper end passed through a bearing fixed in a rigid frame and carried a protractor. A sight tube in one side of the tank was provided so that the radiometer could *see* the sample. The inside surface of the cylinder was blackened with paint which had a hemispherical emissivity of 0.90. This arrangement provided an environment of known temperature and emissivity so that reflected radiation could be accounted for as described in Appendix B.

All temperatures were measured with 30-gage copper-constantan thermocouples made from specially calibrated wire.

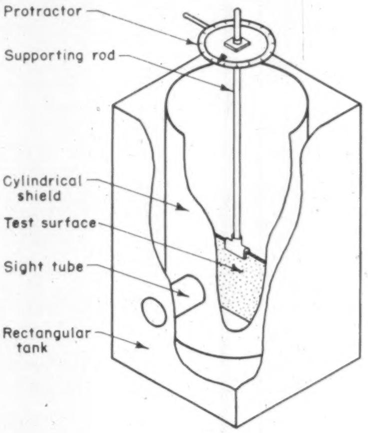
Protractor
Supporting rod
Cylindrical shield
Test surface
Sight tube
Rectangular tank

Fig. 3—Method of shielding test surface from stray radiation

Test Procedure

The radiometer was first calibrated by the procedure given in Appendix A and was subsequently checked at intervals throughout the period of the tests. Determination of emissivity required a measurement of the radiometer output while the black body shutter covered the radiometer tube, a measurement with the shutter removed so the thermopile could *see* the sample, and finally a second measurement with the shutter covering the tube. Temperatures of the sample, the cylindrical shield surrounding the sample, the radiometer shutter, and the radiometer were also recorded. These readings were repeated for each angle at which the sample was viewed. Reduction of the data, including corrections for reflections and temperature drop across the sample thickness, is described in Appendix B.

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[1] Exponent numerals refer to References.

Results

The variation of emissivity with angle was determined for the surfaces listed in Table 1, which gives the total hemispherical emissivity and the normal (perpendicular) emissivity. Figs. 4 and 5 show the variation in emissivity, ε, with angle of emission, θ. The hemispherical emissivity was computed in the following manner. Any radiating surface element emits radiation through a hemispherical envelope. If this envelope is divided into spherical zones, the hemispherical emissivity, ε_h, can be found by the following equation:

$$\varepsilon_h = \frac{\sum\limits_{\theta=0}^{\theta=90} \varepsilon_\theta A_\theta \cos\theta}{\sum\limits_{\theta=0}^{\theta=90} A_\theta \cos\theta}$$

where

θ = angle of emission, degrees, measured from the perpendicular to the surface.

$\varepsilon\theta$ = emissivity at angle θ.

$A\theta$ = area of hemispherical zone of unit radius corresponding to the average angle θ.

In the computations, nine zones of 10 deg width were used.

The table shows that the hemispherical emissivity, ε_h, is approximately equal to 0.95 times the normal emissivity. The values in Table 1 are based upon the curves shown in Figs. 4 and 5. All values shown in these figures were obtained with the 0.3-in. auxiliary diaphragm on the radiometer. Sample temperatures ranged from 100 to 125 F except for one run on sample No. 1 at 150 F. In this range, temperature appeared to have no significant influence on emissivity. Where necessary, all values have been corrected for temperature drop across the paint film. In several cases, measurements at low emission angles were made with 0.2 and 0.5-in. auxiliary diaphragms. The results were the same as those obtained with the 0.3-in. diaphragm.

The results are influenced by errors in measuring the radiometer outputs and the temperatures and errors in corrections for reflections A possible error of ± 0.5 percent in the potentiometer-amplifier circuit introduces an error of about the same amount in the emissivity value. Associated with this are uncertain errors in applying corrections for the effect of water vapor absorption on the instrument constant. These corrections were determined after the measurements and the dew points prevailing in some tests had to be estimated. The maximum error in allowing for water vapor absorption probably is less than ± 0.5 percent.

The absolute value of the temperatures measured is accurate to within about 0.2 deg, the probable accuracy of the wire calibration. On a relative scale, each temperature is accurate to perhaps ± 0.1 deg so that the maximum error introduced in the emissivity value is ± 1.0 percent with the average error about half this value. The temperature drop across the paint films was estimated with an error of about 20 percent, but since the drop is small, the error introduced into the final result is small, about ± 0.3 percent.

Table 1—Normal and Hemispherical Emissivity of Surfaces

No.	Surface Description	ϵ_n	ϵ_h
1	⅛-in. thick aluminum plate with two coats of reddish brown primer[a] and one coat of light gray paint[b], all coats sprayed on.	0.92	0.88
2	⅛-in. thick copper plate, flame oxidized.	0.26	0.27
3	Same as No. 2, with one coat of reddish brown primer[a] added, brush applied.	0.90	0.85
4	Same as No. 3, with one coat of flat black[c] added, brush applied.	0.87	0.83
5	Same as No. 4, with one coat of lampblack[d] added, brush applied.	0.95	0.90
6	Weathered roofing asphalt (melting at 180 F approx.) on ⅛-in. thick aluminum plate.	0.91	0.88
7	1/16-in. thick aluminum with anodized coating 11 x 10^{-5} in. thick; specular reflecting surface.	0.67	0.65

[a] Reddish brown primer

Pigment (60% by weight)	% by weight
Zinc chromate	20
Red lead	25
Zinc oxide	15
Iron oxide	20
Magnesium sulphate	20

Vehicle (40% by weight)	% by weight
Vegetable oils	24
Varnish	50
Japan drier	15
Mineral spirits	11

[b] Light gray paint

	% by weight
Titanium dioxide	6.5
Titanium calcium pigment	39.5
Soya-alkyd resin	24.0
Mineral spirits, driers	30.0

[c] Flat black enamel paint

[d] Lampblack mixed with 4-lb cut shellac and thinned with alcohol.

Errors in correcting for reflections in the case of the diffuse-reflecting surfaces are believed to be negligibly small. In the case of the specular reflecting aluminum, the error is perhaps ± 2.0 percent. Therefore, considering all the errors listed, the emissivity values given are probably accurate to within ± 2.0 percent for all but the specular reflecting aluminum, for which the probable accuracy is ± 4.0 percent.

Discussion of Results: Schmidt and Eckert[2] applied electro-magnetic wave theory and the Fresnel reflection formulas to show that emissivity varies with the angle of emission. For surfaces of non-conductors, they showed that the value of emissivity stays constant between normal and 50 to 60 deg from normal, after which it begins to decrease at an increasing rate, reaching zero as a limit at 90 deg from normal. For metals, the emissivity is constant out to about 45 deg from normal, then increases until the angle reaches about 75 deg, after which it drops to zero at 90 deg from normal. Measurements for common substances by Schmidt and Eckert[2] are in close agreement with theory.

Figs. 4 and 5 show that the painted surfaces have the characteristic behavior of non-conductors and follow the theory developed by Schmidt and Eckert. Estimated corrections for temperature drop across the paint film have been applied to all values. The normal value for lamp black, 0.95, is in close agreement with published values. It is of interest to note that the metal primer has a slightly higher emissivity than the flat black paint.

The values for the copper oxide surface show some metallic properties, possibly because the oxide film may have been so thin that some characteristic of the copper showed through the oxide coating. Comparisons with other data for copper oxide are valueless because film thickness is an important variable and is usually not known.

The asphalt behaves as a nonconductor. Because of the thickness of the layer applied to the heating plate, special tests were made to determine the temperature drop across the layer.

The specular reflecting oxide coating (anodized) aluminum also behaves as a non-conductor, despite the thinness of the oxide coating, which was measured by others[3] and found to be 0.00011 in. in thickness. In regard to this, Taylor and Edwards[4] have studied the variation of emissivity of anodized aluminum with film thickness and found that for thickness of 0.00002 in. (3 to 5 times the thickness of a natural oxide coating) the emissivity is about 0.11. It increases rapidly with thickness until the film thickness is about 0.00008 in., for which the emissivity is about 0.63. Greater thicknesses cause very small increases in emissivity. In this instance, the measured value of 0.67 (based upon the two series of test results plotted) checks the value of 0.67 that would be predicted from the work of Taylor and Edwards and also compares well with a value of 0.64 determined by a recent measurement[3] in which the Taylor and Edwards apparatus was used. (An average of nine normal incidence determinations gave a value of 0.68.)

It should be noted that the light absorptance of anodized aluminum with this coating thickness of 0.00011 in. is about 0.16 (see Reference 4) as compared with its absorptance (emissivity) of 0.68 for low temperature radiation. This absorptance for light is substantially the same as that for commercial aluminum foil[4], which has an emissivity of about 0.05 for low temperature radiation.

It is also of interest to point out that measurements[5] of the light absorptance of a number of materials and paints for angles of incidence between zero and 90 deg yield curves similar in shape to those given in this paper. For angles greater than

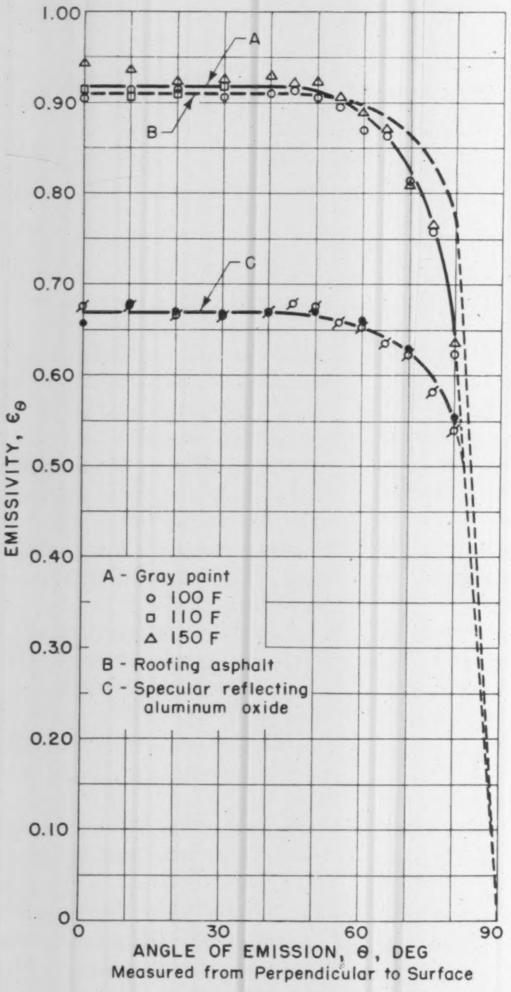

Fig. 4—Emissivity *vs* angle of emission for gray paint, specular reflecting aluminum oxide and roofing asphalt

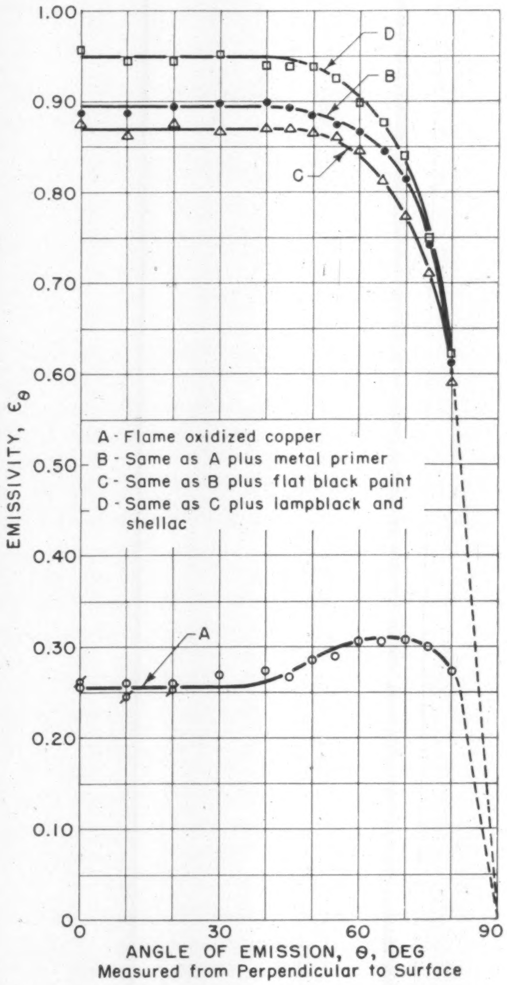

Fig. 5—Emissivity *vs* angle of emission for oxidized copper coated with several different paints

60 deg, the absorptance decreases rapidly and reaches zero at 90 deg. The absorptance of glass for sunlight behaves similarly.

Conclusions

Based upon the data presented, the following conclusions can be drawn:

1. The emissivity of the painted surfaces investigated decreased as the angle of emission increased in accordance with the theory for non-conducting materials. A specular reflecting aluminum oxide coating behaved in similar fashion.
2. Hemispherical emissivity for these surfaces is very closely 95 percent of the normal emissivity.

Acknowledgment

The authors acknowledge with thanks the suggestions and assistance of members of the staff of the ASHVE Research Laboratory in this work and in particular the assistance of R. O. Hancock. They also acknowledge the technical data received from the Aluminum Company of America.

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APPENDIX A

The Radiometer

The radiometer, a commercial instrument, was a Moll-type thermopile consisting of 66 short thermo-elements mounted inside and near the closed end of a tube (see Figs. 1 and 2). The series of rectangular diaphragms fitted in the tube minimized convection effects. The water jacket acted as a temperature stabilizer and minimized drift of the thermopile temperature.

To adapt the instrument to this work, the following techniques were employed:

1. To avoid impractically large sample sizes for emissivity measurements at high angles of emission, a diaphragm was placed immediately in front of the largest diaphragm in the radiometer tube to reduce the horizontal dimension from 0.905 in. to 0.300 in.

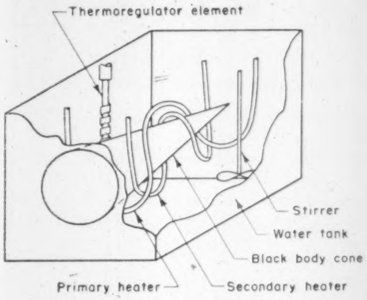

Fig. A-1—Cut away view of bath showing black body and heaters

2. With the new diaphragm arrangement, the radiometer had an angle factor of 0.002585, *i.e.*, when sighting a black body surface, the thermopile intercepted about 0.26 percent of the total radiant energy emitted by that surface. Consequently, the output of the radiometer for the sample temperature range used was of the order of a few microvolts. The output was therefore magnified by 200 by means of a standard d-c amplifier and then measured by a precision potentiometer and a light beam galvanometer. The latter had a sensitivity of 0.47 microvolts per millimeter deflection of the light spot. Special lead wires to connect the radiometer terminals to the amplifier were essential to avoid pick-up of stray emfs.
3. It was observed that the instrument usually had a definite output when the radiometer was closed off by the shutter. This was attributed to small temperature differences between the thermopile cold junctions, the shutter, and the tubular housing which gave rise to a net radiation exchange. In order to measure accurately the contribution of the shutter and to eliminate, as described later, the contribution of the housing, the flat two-leaved shutter provided with the instrument was replaced by a small conical black body of solid aluminum. Like the shutter, it could be moved into and away from the line of sight of the radiometer.
4. To minimize radiation and convection effects from the surroundings, the radiometer housing was enclosed with aluminum foil.
5. Readings were found to be unreliable in windy weather. Adiabatic compressions and expansions of the room air due to external wind effects were found to be responsible.

The sensitivity and the response of the radiometer were found to be satisfactory. A change of about 0.45 x 10^{-6} Btu/hr in the amount of radiation falling on the thermopile area could be detected in the radiometer output and the instrument had an almost immediate response.

Radiometer Calibration

A blackened cone heated by a water bath met the requirements of a black body (see Fig. A-1) for calibration. The cone was of ⅛-in. thick sheet copper with a 30 deg included angle and 4-in. diameter base. It was determined that any ray of radiation which fell on the conical surface between the apex of the cone and about 3 in. from the base was reflected at least three times. Hence, with the black surface having a hemispherical emissivity of 0.90, this section was judged to have an effective emissivity of substantially unity. The conical surface *seen* by the radiometer was restricted to this section.

The bath was heated by two flexible electrical heaters coiled around the outside of the cone. One (500 watts) was manually controlled by an auto-transformer; the other (50 watts) was controlled by a thermo-regulator in the water bath. A stirrer provided even temperature distribution. With this arrangement, the black body could be maintained constant to within 0.1 deg at any temperature up to 200 F.

Calibration was carried out as follows. The black body described previously was heated to the desired temperature. When equilibrium conditions were obtained, a series of three observations were made. The first was the radiometer output when the radiometer tube was closed by the small conical black body shutter (see Figs. 1 and 2), hereafter referred to as black body No. 1. The second was the output when the shutter was moved to one side and the instrument was allowed to see the black body heated by the water bath, hereafter referred to as black body No. 2. The third observation was the output when the radiometer was again covered by the shutter, black body No. 1. Temperatures of the black bodies and of the radiometer water jacket were also observed. The latter was substantially that of the radiometer thermopile.

Several factors must be considered in determination of the radiometer constant and its subsequent use in calculation of radiation quantities from observations of the radiometer output. *First*, inequalities between the temperature of the thermopile element, the temperature of the tubular housing and the temperature of the shutter invariably existed. Hence, the instrument had a small output when the tube was closed off by the shutter. Since full response was reached in but a few seconds, the time elapsed during the sequence of the three readings referred to above was so short that changes in this *zero* output were either zero or so small that its change with time could be regarded as linear. As will be shown, this *zero* output could be eliminated from the output observed when the instrument sighted the black body. *Second*, the constant is dependent upon the mean temperature of the thermopile so that this dependence must be established. *Third*, water vapor in the line of sight absorbs a part of the radiation emitted by the object sighted and also contributes to the radiant energy which falls on the thermopile. The following equations express the relationship between radiometer outputs, its constant and the radiant exchanges between the thermopile and the objects which it *sees*:

1. Shutter open, radiometer sighted on black body:

$$\mathrm{emf}_1/C = A_r F_{r-s}\,\sigma[(1-\epsilon_2)\,T_{b2}^4 + \epsilon_2\,T_2^4 - T_r^4] + R \qquad \text{(A-1)}$$

2. Shutter closed:

$$\text{emf}_2/C = A_rF_{r-s}\,\sigma[(1-\epsilon_1)\,T_{b1}^4 + \epsilon_1\,T_1^4 - T_r^4] + R \quad \ldots\ldots\ldots\ldots \text{(A-2)}$$

where

emf = radiometer output in microvolts.

C = radiometer constant, μV per Btu per hour which falls on the thermopile area.

A_r = area of the radiometer thermopile, square feet (taken as the area of the diaphragm immediately in front of the pile).

F_{r-s} = angle factor of the thermopile (the fraction of the radiation which passes through the outermost diaphragm that falls upon the thermopile).

σ = Stephan-Boltzman constant = 0.173 x 10^{-8} Btu per (hour) (square foot) (Fahrenheit degree, absolute^4).

T_{b1} = temperature of the black body shutter, Fahrenheit absolute.

T_{b2} = temperature of the black body, Fahrenheit absolute.

T_r = temperature of the radiometer thermopile (jacket temperature), Fahrenheit absolute.

T_1 = average temperature of the water vapor column inside the radiometer tube, Fahrenheit absolute.

ϵ_1 = emissivity of this water vapor column, dimensionless.

T_2 = average temperature of the water vapor column between the thermopile and object sighted, Fahrenheit absolute.

ϵ_2 = emissivity of this water vapor column, dimensionless.

R = net radiant energy exchange between the thermopile and its housing, Btu per hour.

Subtraction of Equation A-2 from Equation A-1 eliminates the unknown value of R and also the temperature of the thermopile itself, so that

$$[(\text{emf})_1 - (\text{emf})_2]/C = A_r\,F_{r-s}\,\sigma[(T_{b2}^4 - T_{b1}^4) - \epsilon_2\,(T_{b2}^4 - T_2^4) - \epsilon_1\,(T_1^4 - T_{b1}^4)] \quad \ldots\ldots \text{(A-3)}$$

Ordinarily, temperatures T_2 and T_1, the latter substantially equal to T_r, are nearly equal to T_{b1}, so that with negligible error Equation A-3 can be simplified as follows:

$$[(\text{emf})_1 - (\text{emf})_2]/C = A_rF_{r-s}\,\sigma[(T_{b2}^4 - T_{b1}^4)\,(1-\epsilon_2)] \quad \ldots\ldots\ldots \text{(A-4)}$$

Calibration over the temperature range 80 to 105 F and a range in ϵ_2 from 0.016 to 0.074 (dew points 22 to 78 F) established the constant at 2.183 x 10^4 microvolts per Btu per hour radiation incident upon the thermopile area at 75 F. The correction for temperature was 0.0018 x 10^4 increase in C per F deg decrease in radiometer temperature.

APPENDIX B

Calculation of Emissivity from Experimental Data

The determination was similar to that followed in calibration, that is, the radiometer first *saw* the shutter at the end of the tube, black body No. 1, then the sample surface and once again black body No. 1. The outputs were recorded in each case. The output of the radiometer when it sighted the sample was due primarily to the net radiant energy exchange between the sample and the radiometer. However, it also included radiation from the surroundings as follows:

1. Radiation originating at the shield surface and being reflected from the sample surface into the radiometer.
2. Radiation originating at the sample surface and being reflected from the shield surface back to the sample surface and into the radiometer.
3. Radiation originating at the thermopile, a part of which is reflected from the sample back to the thermopile.
4. Radiation originating at either the shield surface or the sample surface and reaching the radiometer thermopile after multiple reflections.

The effect of item 4 is very small compared to the total reflected radiation and will not be considered. The contributions of items 1 and 2 are:

$$S_1 = A_rF_{r-s}\,\sigma(1-\epsilon_2)\,[\epsilon_{sh}'\,(1-\epsilon_s)\,T_{sh}^4] \quad \ldots\ldots\ldots\ldots \text{(B-1)}$$

$$S_2 = A_rF_{r-s}\,\sigma(1-\epsilon_2)\,[\epsilon_s\,(1-\epsilon_{sh})\,(1-\epsilon_s)\,(A_s/A_{sh})\,T_s^4] \quad \ldots\ldots\ldots\ldots \text{(B-2)}$$

where

ϵ_{sh} = hemispherical emissivity of the cylindrical shield surface, dimensionless.

ϵ_{sh}' = effective emissivity of the cylindrical shield, dependent on ϵ_{sh} and ratio of the shield to sample areas, dimensionless.

ϵ_s = emissivity of the sample, dimensionless.

A_s = area of the sample, square feet.

A_{sh} = area of the shield, square feet.

T_s = temperature of the sample surface, F, absolute.

T_{sh} = temperature of the shield surface, F, absolute.

The contribution of item 3 is

$$S_3 = A_rF_{r-s}\,\sigma T_r^4\,(1-\epsilon_2)\,(1-\epsilon_s)\,(1-\epsilon_2)\,M \quad \ldots \text{(B-3)}$$

where

M = fraction of the reflected radiation that can be intercepted by the thermopile, dimensionless.

For diffuse reflecting surfaces, M is substantially zero in the apparatus described in this paper. For specular reflecting surfaces, M = 0.02 approximately for normal incidence viewing and zero for all other angles. The direct contribution of the sample and the water vapor column is:

$$A_rF_{r-s}\,\sigma[\epsilon_sT_s^4\,(1-\epsilon_2) + \epsilon_2T_2^4] \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(B-4)}$$

The radiometer develops an emf proportional to the net exchange between the thermopile and the objects it *sees*. When the instrument views the sample, this net exchange is:

$$\text{emf}/C = A_rF_{r-s}\,\sigma[\epsilon_sT_s^4\,(1-\epsilon_2) + \epsilon_2T_2^4] + S_1 + S_2 + S_3 + R - A_rF_{r-s}\,\sigma T_r^4 \quad \ldots\ldots\ldots \text{(B-5)}$$

By subtracting Equation A-2, which gives the emf when the shutter closes the end of the tube, the unknown R is eliminated. As before, in developing Equation A-4, the temperature of the water vapor column inside the tube and between the tube and the sample are taken equal to the temperature of the shutter. Solving for ϵ_s gives the following equation:

$$\epsilon_s\,(T_s^4 - \epsilon_{sh}'T_{sh}^4) = [(\text{emf})_1 - (\text{emf})_2]/[A_rF_{r-s}\,\sigma\,C(1-\epsilon_2)] + T_{b1}^4 - [\epsilon_{sh}'T_{sh}^4 + 0.132\,T_s^4\,(1-\epsilon_{sh})\,(1-\epsilon_s)\,\epsilon_s + T_r^4\,(1+Y)] \quad \ldots\ldots\ldots\ldots \text{(B-6)}$$

where

$Y = M\,(1-\epsilon_s)\,(1-\epsilon_2) - 1$

A_s/A_{sh} = 0.132 in the present apparatus.

Note that ϵ_s appears in one of the quantities in the bracketed term in the numerator and also in Y. Equation B-6 is most easily evaluated by estimating ϵ_s and then recalculating if necessary. Ordinarily, no further refinement is required. ϵ_{sh}' was taken as unity for diffuse reflecting surfaces.

The specular reflecting surface presented a special problem in that only radiation from the shield that reached the sample at or very near the angle of viewing could reach the radiometer via a specular reflection. Hence, the effective emissivity of the shield was not necessarily unity. Moreover, the effective emissivity would be different for normal emissivity than for all the other angles because of the sight tube. ϵ_{sh}' was therefore experimentally determined by making tests with the shield at two different temperatures with the viewing angle, θ, equal to zero in both cases. Since for angles close to zero incidence, ϵ_s is the same, this factor was then used to find ϵ_{sh}' for angles other than normal incidence by equating expressions for ϵ_s. The effective shield emissivity, ϵ_{sh}', was found to be 0.882 for normal incidence and 0.90 for other than normal. The values of ϵ_{sh}' determined included approximately the term 0.132 $T_s^4\,(1-\epsilon_{sh})\,(1-\epsilon_s)\,(\epsilon_s)$.

In some cases the sample may be so thick as to cause an appreciable temperature drop through it. This was true in the case of the asphalt, and therefore tests with two different thicknesses were made in order to estimate the temperature drop. This estimate checked very closely with direct measurement by thermocouples. Another way to minimize the possible error in determination of the temperature of the sample surface is to maintain the shield temperature at the temperature of the sample. The only heat loss to cause a temperature drop is that occasioned by the small radiation exchange between the sample and the radiometer. Temperature drop across the paint films was estimated by measuring the film thickness and calculating the temperature drop.

Air Conditioning of Multi-Room Buildings

By R. W. Waterfill*, New York, N. Y.

SUMMARY — Multi-room buildings, such as offices, apartments, and private homes, present special problems in air conditioning and constitute a distinct air conditioning classification. Special methods are being developed to handle these problems, each general method having many modifications to fit the individual building. The most essential requirement is a high degree of flexibility that will permit individual room control regardless of variations or shifts in thermal loads in any part of the building. The characteristics of the principal systems currently used are discussed, with particular analysis of their behavior, supervision and operating costs. Ventilation, air cleaning and humidity variations are discussed in some detail. The analysis is applied to an assumed typical office building, and while many of the assumed details can be modified, it is believed the results indicate the performance to be reasonably expected of the systems.

THERE ARE several basic air conditioning systems and many modifications of each are presently applied to multi-room buildings. Principal ones are the single-duct primary with room secondary, the dual-duct, conventional low pressure central station, and room-unit systems. The single-duct primary and dual-duct systems will be compared in detail here and the other systems will be discussed generally.

Single-Duct Primary System

Fig. 1 illustrates the single-duct primary system. It takes outdoor air, or a mixture of outdoor air with a small quantity of return air, which is filtered, cooled, and delivered in fixed proportions to each room unit. While it is possible to use only ventilation air in the primary with no recirculation return to the central apparatus, this is desirable only if ventilation requirements are relatively large.

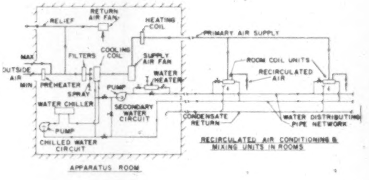
RETURN AIR FAN
RELIEF
HEATING COIL
PRIMARY AIR SUPPLY
MAX
OUTSIDE AIR
MIN
FILTERS
COOLING COIL
SUPPLY AIR FAN
ROOM COIL UNITS
RECIRCULATED AIR
WATER HEATER
PREHEATER
SPRAY
PUMP
WATER CHILLER
SECONDARY WATER CIRCUIT
CONDENSATE RETURN
WATER DISTRIBUTING PIPE NETWORK
PUMP
CHILLED WATER CIRCUIT
RECIRCULATED AIR CONDITIONING & MIXING UNITS IN ROOMS
APPARATUS ROOM

Fig. 1—Single-duct primary system

Air is delivered at the room units under sufficient pressure to induce room-air recirculation flow through the room-unit coils, where it may be heated or cooled. The ratio of room-air circulation to primary air supplied may be 3 to 1 in volume and may range from 1 to 1, to 2 to 1 in room sensible heat capacity, being governed by noise levels, secondary condensation, air changes, and similar variables. The room coils are supplied with warm or cold water according to the operating needs of a particular zone, which accounts for the careful zoning required. At the peak of the cooling or heating season, the primary and secondary functions are the same, but at intermediate seasons the primary system may tend to overcool some rooms so that secondary reheat must be available in the room coils. Both air and water should be carefully zoned to have the necessary flexibility in each space conditioned.

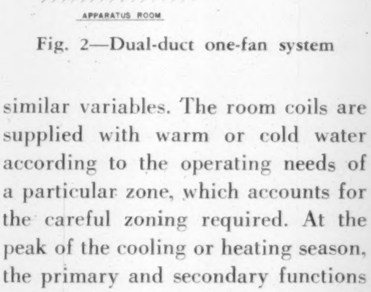
RETURN AIR FAN
RELIEF
HEATING COIL
AIR MIXING UNIT
FILTERS
WARM AIR SUPPLY
MAX
OUTSIDE AIR
MIN
COOLING COIL
COLD AIR SUPPLY
SPRAY
PREHEATER
SUPPLY AIR FAN
TO OUTLETS
WATER CHILLER
AIR MIXING UNITS
PUMP
CHILLED WATER CIRCUIT
APPARATUS ROOM

Fig. 2—Dual-duct one-fan system

Dual-Duct Systems

Fig. 2 outlines the basic air handling and distributing principle of the dual-duct one-fan system. The entire air supply is filtered and delivered to warm and cold air distributing ducts. The flexibility of the warm and cold air dual supply insures individual room temperature control rather than zone control at all seasons of the year.

Among the principal advantages of the dual-duct system are its flexibility and automatic response to shifts in demands, without the necessity of cycle change-over as required by systems using warm or cold air or water alternately in a single-duct or water-pipe distributing network. Mixing units in each room draw air from both the warm and cold ducts in any desired proportion to satisfy the individual room temperature. Since there are two ducts, there is some tendency for the air volume at each outlet to vary. While this in no way affects temperature control, it could disturb distribution and air movement. Volume is, therefore, maintained uniform by one of two means: (1) in zones by static pressure regulators, or (2) by volume regulators at each outlet.

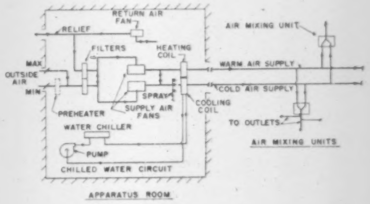
RETURN AIR FAN
RELIEF
AIR MIXING UNIT
FILTERS
HEATING COIL
MAX
OUTSIDE AIR
MIN
WARM AIR SUPPLY
COLD AIR SUPPLY
SPRAY
PREHEATER
SUPPLY AIR FANS
COOLING COIL
TO OUTLETS
WATER CHILLER
AIR MIXING UNITS
PUMP
CHILLED WATER CIRCUIT
APPARATUS ROOM

Fig. 3—Dual-duct two-fan system

Fig. 3 shows another dual-duct system, but with two fans arranged so as to effect a practical separation of return and outside air. Otherwise, its operation is the same as the dual-duct one-fan system. It is slightly more expensive and requires more apparatus floor space but it reduces refrigeration and reheat operating costs and maintains stable humidity over a wide range of conditions without reheat. Its advantages increase as the latent heat loads increase.

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In the cooling season the warm air supply of the dual-duct systems is maintained at about room temperature, so that reheat is not ordinarily required, but it could be obtained in the separate warm-air duct by economical reverse cycle means, that is, from the refrigerant condenser. In the heating season, cooling and dehumidifying are obtained from outdoor air. This system is flexible and stable so that even a room with no internal heat load can achieve good control from the heat available from loaded rooms on the system. Heat generated in one area is automatically transferred to another heat-deficient room to produce good control without the addition of external heat from an artificial source.

Conventional Low-Pressure System

The conventional low-pressure system has long been used where air conditioning load patterns are relatively stable and where recirculated air can be returned to the central conditioning apparatus for treatment or by-passed as zone conditions require. Control is accomplished at the central apparatus, thus is not flexible enough for multi-room applications.

High-Pressure Central System

Fig. 4 shows a high-pressure central system which uses reduced air volumes at high temperature differentials, and relatively high duct velocities. Its single supply temperature for each zone is established in the central plant; thus variations in individual rooms must be compensated for by throttling the air supply volume. Reductions of more than 25 percent upset distribution and circulation. When 100 percent outside air is supplied to the enclosure, heat and refrigeration requirements are excessive and adequate relief or exhaust means must be provided. Windows are unsatisfactory reliefs since they admit noises, dirt, and wind and are unpredictable. For this and other reasons, this system is not included in the detailed analysis.

Room-Unit Systems

Room-unit systems are of dubious adaptability to multi-room buildings, chiefly because of their control and ventilation characteristics. They are either filter fan and coil units which are supplied with chilled or hot water from a central plant, or self-contained units which include a refrigerating system. The electric wiring, water, ventilation, filtering, humidity characteristics and servicing of a vast number of such units generally precludes their consideration in large buildings. Servicing problems tend to multiply with time. For interior zones, ventilation and condenser problems increase. The partial load performance of room units is also poor, resulting in a high seasonal average power consumption.

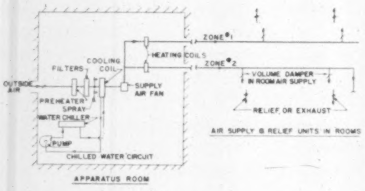

Fig. 4—Modified central station system with 100 percent outside air — no recirculation

Ventilation and Filtering

Ventilation is a vital function of air conditioning. Present air conditioning practice generally provides more positive and generous ventilation than was ever enjoyed in non-air-conditioned buildings and possibly even in some sections of open-air sports stadiums.

Good engineering demands that the thermal and circulation requirements be considered independently of ventilation. The proper design approach is to determine ventilation requirements from the nature of the occupancy and accepted codes or practices of recognized groups. Excessive or fixed ventilation can be wasteful.

Fig. 5 gives some indication of the cost of outdoor air at temperature extremes. For instance, a cooling system using 100 percent outside air at 75 F wet bulb requires a refrigeration plant capacity considerably in excess of a system restricted to ventilation needs at these peak conditions. Assuming for illustration an average internal sensible heat load of 25 Btu per (hr) (sq ft) of floor area and a 50 F cold-air supply temperature, the calculated air volume required to maintain an 80 F room temperature is 0.80 cfm per sq ft. Fig. 5 shows that if this total volume is taken from outdoors, the refrigeration demand due to the ventilation air would be 0.0024 tons per sq ft of floor area for the example illustrated, whereas if the outdoor air is limited to the ventilation requirement of 0.20 cfm per sq ft, the refrigeration demand due to the ventilation air would be 0.0006 tons per sq ft. The corresponding *total* load would be 0.00508 and 0.00328 tons respectively. This is not an extreme case, yet the use of 100 percent outdoor air would require a refrigeration plant 1.55 times as large as need be.

When outdoor air wet-bulb temperatures are lower than interior wet-bulb temperatures, it is decidedly advantageous to make use of available outdoor air to reduce the cooling load and to reduce the required hours of operation of refrigeration equipment, as shown in Fig. 5.

For example, if the outside air is limited to the minimum ventilation value of 0.20 cfm per sq ft at 55 F wet bulb, its cooling capacity in an 80 F room is only 0.0005 tons. This still leaves approximately 0.0015 tons per sq ft mechanical refrigeration requirement, allowing a transmission load reversal of 0.0007 tons. However, utilizing the full system capacity of 0.80 cfm outside air per sq ft or four times the minimum, provides 0.002 tons cooling capacity and permits shutting down the mechanical refrigeration system.

During the heating season, the penalty of 100 percent outdoor air is even greater, the required capacity of the heating plant being nearly double that of a system which provides for recirculation. There are special situations like certain hospital wards where recirculation between zones is not permissible. but this does not alter good practice in general multi-room structures.

The purpose of ventilation is the dilution of impurities. Present tendencies are toward overemphasis, except in public enclosures like subways. Window area is often used as a ventilation index, though windows in non-air-conditioned structures are often closed, weatherstripped and sealed. Offices on the leeward side of such buildings get no direct ventilation. the windows serving merely as air relief vents for the rest of the building. Windows in non-air-conditioned structures are generally opened only for the available cooling effect of outside air and not for true ventilation purposes.

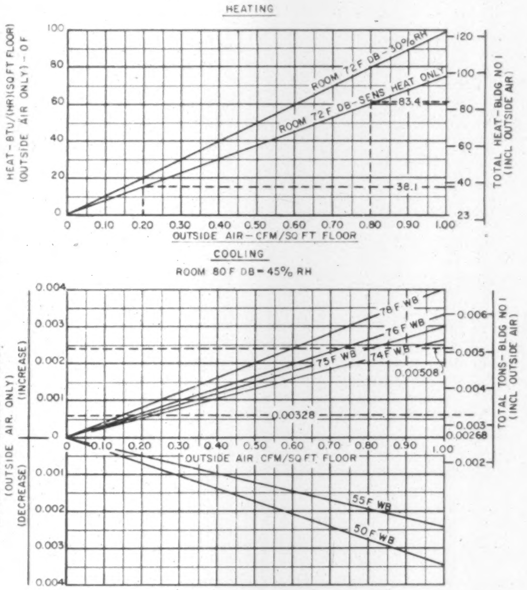

Fig. 5—Ventilation load per square foot of floor area

Ventilation should be based on some fixed criterion such as cubic volume or square feet of floor area of the conditioned space or on the population density, and should take into account the activity in the building. Industrial fumes and food odors require special treatment not considered here. Basing ventilation on percentage of fan capacity is erratic. Current ventilation standards, when adhered to, result in a high purity of the air in conditioned spaces.

Another desirable function of air conditioning, rivaling ventilation, is physical cleanliness of the air. Conditioned air in cities should be, and generally is, cleaner than outdoor air. Some dirt originates within the conditioned space itself and is being constantly raised and resettled. A desirable feature of returning recirculated air to a central apparatus is that a large volume of the room air and dust can be filtered in efficient types of filters. The maintenance of a central filter system is more effective and the cost of air filtration is lower than for similar usage in a dispersed filter system. The cleaning of room units, if not equipped with efficient individual filters, is an added problem and is comparatively costly.

The room filtered air change rate is important in maintaining high standards of cleanliness. When the air is recirculated through widely scattered room conditioning coils, dirt and odors tend to accumulate, with the result that ventilation objectives are largely lost.

With the single-duct primary and dual-duct one-fan systems, the ventilation to all conditioned spaces is effective under any control position, that is, no space will receive less dilution of its air volume by outside air than established by the system adjustment. Ventilation in a dual-duct two-fan system under some conditions could be reduced, but probably not more than 10 percent in any room, if the warm air is maintained high enough to balance the excess cooling effect of the ventilation air in winter.

With the single-duct primary system, use of outdoor air and filtering is limited generally to the primary air supply. The dual-duct system can supply up to 100 percent ventilation and does filter the total air quantity at the central apparatus.

Humidity

Room humidity depends on the internal moisture load, the moisture content of the air supplied to the room and the room sensible heat or reheat. Close control of relative humidity is not essential nor attempted in comfort conditioning. The principal comfort concern is to avoid humidities in excess of 50 percent. In winter the humidity will be considerably lower, condensate on windows being a deterrent to high indoor humidities when outdoor temperatures are low.

Figs. 6, 7, 8 and 9 indicate the humidity behavior of installations of single-duct primary and dual-duct one-fan systems under assumed typical conditions. The cold air supply dew point temperatures have been assumed the same, at 51 grains per pound of air, for each analysis, so that the resulting humidities properly reflect the behavior of each system. The curves clearly establish the characteristics of each system. It is unlikely that the zone sensible heat will fall below 20 to 25 percent, as at *M*, for the outside conditions established and for exterior spaces. However, the lower room sensible-heat percentages are possible for an interior zone or when outside dry-bulb temperatures are as low as those inside.

In the single-duct primary system (Figs. 6 and 7) the humidity remains constant for a fixed primary supply and internal moisture load, as along *A*, until the sensible-heat gain of the room drops below the cooling capacity of the primary air. The tendency then is to overcool the room with a resulting rise in humidity along the slanted lines. If the internal moisture load remains constant at 20 grains, the humidity rises along the solid lines, but if it diminishes uniformly to zero with the sensible heat from *S*, it will follow the broken line. The resulting drop in room temperature without reheat is indicated on the slanted lines. The humidity effect resulting from designing the system for a lower primary air volume is shown in Fig. 7. The smaller volume is not desirable because it would increase refrigeration operating hours and result in secondary coil condensation.

If any room on the supply system of this or of any other single-duct system is devoid of internal sensible and latent heat, it will overcool unless reheat is used. While heat storage and leakage from adjacent spaces retard the overcooling of a single room, the tendency is for the room to approach the temperature of the primary air supply, which is cold if it has not already received reheat. Line *C* indicates the limiting condition of such a room. In order to prevent any overcooling, it is necessary that reheat be available to this room with no load, and that either the primary or secondary circuit of the entire zone must carry reheat. One difficulty is that the circuit may have to be changed over from reheat to cooling and back again in a few hours.

The humidity behavior of the dual-duct one-fan system is affected by the outside air moisture content. Figs. 8 and 9 are presented to show this effect. Line *A* shows the change in zone humidity with variations of room sensible heat. Reheat applied when this line crosses the 50 percent relative humidity line holds room conditions along *A′*. It will be noted that in both Figs. 8 and 9, reheat is not needed when internal sensible heat exceeds 20 and 25 percent. Even the individual room with no internal load, indicated by line *C*, maintains a temperature of 80 F and a relative humidity below 50 percent when it is on a zone supply having an average sensible heat in excess of 30 percent. This is because the dual-duct system utilizes the excess heat of loaded spaces to reheat unloaded areas.

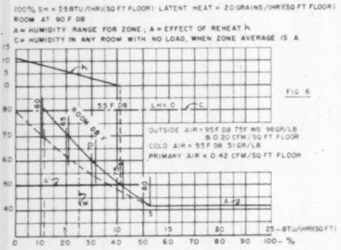

Fig. 6—Humidity behavior of single-duct primary system with 0.42 cfm per sq ft of floor area

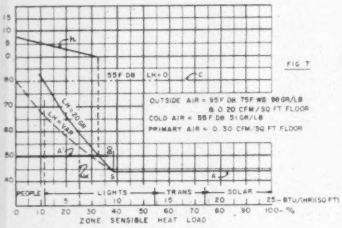

Fig. 7—Humidity behavior of same system with 0.30 cfm per sq ft of floor area

The amount of applied reheat required is the internal sensible heat deficiency, where the humidity begins to exceed its desired value along line *A*. Thus, in order to prevent the humidity from exceeding 50 percent and make it follow line *A′*, reheat begins where *A* crosses the 50 percent relative humidity line and must be applied in the amount *h*, in Btu per square foot of floor area per hr, as shown in the upper scale of the figures. While reheat at these outside air temperatures is unlikely, it is well to have a small amount available at lower temperatures in the interest of good control. The dual-duct system with its separate warm air duct and heating coil in the apparatus room is ideally arranged to obtain this interim reheat from the condenser side of the refrigerant cycle. The humidity curve for the dual-duct two-fan system is flatter than that of the corresponding dual-duct one-fan system.

Typical Application

To illustrate the behavior of systems currently employed in multi-room buildings, a representative New York office building, designated Building 1 (Table 1), with its air conditioning loads is assumed. These loads are average over the total floor area and are instantaneous peaks, instead of totals of all zone peaks, and will vary from zone to zone and from time to time. The distribution system must have the capacity and flexibility to meet all zone peaks and load variations. These comparisons will apply either to an entire building or to any segment of a building, including the periphery, the load averages being as assumed. Building 1 is analyzed in detail, but to illustrate the effect of heavier thermal loading, condensed data on Building 2 are given. In addition to assumed conditions, Table 1 summarizes unit results for both buildings, employing single-duct primary, dual-duct one-fan, and dual-duct two-fan air distribution systems.

Ventilation is 0.20 cfm per sq ft of floor area, equal to 16 cfm per person, and is used only when the building is occupied. During nights or holidays ventilation becomes infiltration of 0.10 cfm per sq ft, or equivalent to one air change every 90 min in the building. The refrigeration load at design conditions for the two buildings becomes 0.00328 tons and 0.0042 tons per sq ft. A refrigeration plant of 1000 tons capacity is then adequate for buildings having 305,000 and 238,000 sq ft, respectively.

The cold air supply temperatures and primary air volumes were selected as representing reasonable and preferred practice, although they can be varied within limits. The cold air dry-bulb temperatures result from choosing a common apparatus dew point, which is established ahead of the fan of the single-duct primary draw-through system and after the fan of the blow through dual-duct system. The difference is approximately the rise after the fan of the single-duct primary system.

If the cold air supply temperature of the dual-duct systems is increased to 55 F, the primary air supply is also increased, but the refrigeration load and hours of operation of the refrigerating system are decreased, with the result that the combined fan and refrigeration kilowatt hours remain substantially unchanged. It is also possible to reduce the primary air volume of the single-duct primary system, but this would again extend the required operating time of the refrigerating system, as well as reduce primary air change in the room. Thus, slight changes in these assumed values would have only slight effect on the final results.

The primary air volumes given in Table 1 are based on the combination of zone loads which give a maximum load for the building and correspond to the refrigeration plant capacity. Due to solar and internal load shifts such as are experienced in cafeterias, conference rooms and similar areas, the total of all zone peak loads exceeds the instantaneous total. Since the air volumes to each zone are fixed, they must be adequate for all zone peaks, that is, they must be in heat balance with all zone peaks, and therefore, the fan capacity of all systems must exceed these values. These volumes, therefore, have been increased 10 percent in estimating the kilowatt-input of the supply and return air fans. The primary air volumes also represent the filtered air supply to the rooms.

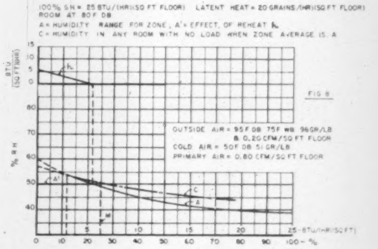

FIG 8

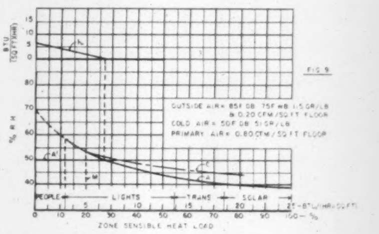

FIG 9

Fig. 8—Humidity behavior of dual-duct one-fan system with 98 grains per lb outside air

Fig. 9—Humidity behavior of same system with 115 grains per lb of outside air

The annual operating cost for electric power, steam and water per sq ft of floor area for the two buildings is almost proportional to their thermal loadings or approximately the same on a refrigeration tonnage basis.

Refrigeration and Heat Demand

Operating costs based on peak load conditions are apt to be misleading unless mean load factors for the specific combinations are well known. This is particularly true in determining refrigeration power input, because of the reduced efficiency of refrigeration plants at light loads, and because some systems operate at reduced loads longer hours than other systems. In order, therefore, to establish the demand for refrigeration power and for heat in relation to changes in outdoor temperatures, the curves, Figs. 10, 11 and 12, were developed. Unit systems would have a much higher average

Table 1—Heating and Cooling Loads, Principal Air Quantities and Unit Annual Operating Costs of a Typical Multi-Room Building in New York

1. COOLING & HEATING LOADS – BTU/HR/SQ FT (AVERAGE) OF FLOOR AREA
2. SUMMER: 95° DB 75° WB OUTSIDE AIR & 80° DB ROOM; WINTER: 0° DB OUTSIDE AIR & 72° DB ROOM

3. BUILDING	NO. 1			NO. 2		
	COOLING		HEATING	COOLING		HEATING
	BTU	%RM SH	BTU	BTU	%RM SH	BTU
4. TRANSMISSION	4.8	19.2	23	6.6	18.9	31.7
5. SOLAR	6.6	26.4		13.0	37.1	
6. LIGHTS (3 WATTS/SQ FT BUILDING NO. 1 3½ WATTS/SQ FT BUILDING NO. 2)	10.7	42.8		12.5	35.7	
7. PEOPLE – SENSIBLE HEAT (1¼/100 SQ FT)	2.9	11.5		2.9	8.3	
8. ROOM – SENSIBLE HEAT TOTAL	25.0	100.0		35.0	100.0	
9. PEOPLE – LATENT HEAT	3.1			3.1		
10. FAN & PUMP	4.0			5.1		
11.@ VENTILATION (0.20 CFM/SQ FT = 16 CFM/PERSON)	7.3		15.1	7.3		15.1
12.@ INFILTRATION (0.10 CFM/SQ FT)			7.55			7.55
13. TOTAL	39.4		46.15	50.5		54.75
14. TONS/SQ FT		.00328			.0042	
15. FLOOR AREA/1000 TONS – SQ FT		305,000			238,000	

	SD	DD		SD	DD	
	PRIMARY	1 FAN	2 FAN	PRIMARY	1 FAN	2 FAN
16. COLD AIR SUPPLY TEMP – °F	55	50+	50+	55	50+	50+
17. PRIMARY AIR CHANGES/HR	2.8	5.3	5.3	3.33	7.4	7.4
18.x PRIMARY CFM/SQ FT	.42	.80	.80	.50	1.12	1.12
19. ROOM CIRCULATION – CHANGES/HR	11.0	11.0	11.0	13.5	15.0	15.0
20. SENSIBLE HEAT CAPACITY PRIMARY – 80° RM	11	25	25	13	35	35
21. ANNUAL OPERATING COST/SQ FT POWER, STEAM & WATER	$0.22	$0.202	$0.194	$0.288	$0.269	$0.258
22. ANNUAL OPERATING COST/TON CAPACITY	$67.2	$61.7	$59.3	$68.5	$64.2	$61.5

23. @ VENTILATION DURING WORK HOURS ONLY; INFILTRATION – IDLE HOURS
24. + IF 55° SUPPLY IS USED THE REFRIG. KW HR. REDUCTION = APPROX. FAN KW HR. INCREASE
25. x THESE AIR VOLUMES ARE IN HEAT BALANCE WITH THE PEAK BUILDING LOADS AND REFRIGERATION PLANT. THE FAN CAPACITY IN EACH CASE MUST EXCEED THESE VALUES BECAUSE OF SOLAR AND INTERNAL LOAD SHIFTS

Table 2—Analysis of Total Annual Costs for a Typical Multi-Room Building in New York

1. AIR CONDITIONING SYSTEMS – OPERATING POWER & WATER COSTS.
2. INTERNAL SENSIBLE HEAT LOAD = 25 BTU/HR/SQ FT AVG.; VENTILATION = 0.20 CFM/SQ FT.

3. AIR DISTRIBUTION SYSTEM	SINGLE DUCT PRIMARY	DUAL DUCT 1-FAN	DUAL DUCT 2-FAN
4. TOTAL HOURS OPERATION – REFRIG. & C.T.	1726	1137	1137
5. OPERATING KW. HRS. REFRIG. (1000 T. – 880 KW)	937,000	682,000	655,000
6. OPERATING KW. HRS. – FANS & PUMPS (2600 HRS.)	1,054,500	1,134,000	1,134,000
7. OPERATING KW. HRS. – COOLING TOWER (FAN & PUMP)	219,000	147,000	147,000
8. TOTAL KW HRS. (WORK HRS.)	2,210,500	1,963,000	1,936,000
9. POWER COST AT 2¢/KW. HR. (2600 HRS.)	$44,210	$39,260	$38,720
10. STEAM COST AT $1.00/1000 LBS.	$ 2,200	$ 2,800	$ 1,050
11. COOLING TOWER MAKE-UP WATER AT 25¢/1000 GAL.	$ 1,170	$ 860	$ 800
12. TOTAL – POWER, STEAM, WATER (2600 HRS.)	$47,580	$42,920	$40,570
13. OPERATING KW HRS. FAN OR PUMP (IDLE HRS.)	327,000	283,800	283,800
14. POWER COST AT 2¢/KW HR.	$ 6,540	$ 5,676	$ 5,676
15. STEAM COST AT $1.00/1000 LBS.	$13,100	$13,100	$13,100
16. TOTAL COST – POWER, STEAM (IDLE HRS.)	$19,640	$18,776	$18,776
17. TOTAL ANNUAL COST – POWER, STEAM, WATER	$67,220	$61,696	$59,346

power consumption. These curves include the progressive changes in heat transmission through walls, ventilation loads and use of extra outside air where advantageous. When the duration of outside temperatures for the various hours of the day, throughout the year, is found from New York City weather records, and the increments of load for each temperature are known, the cumulative power and heat requirements can be determined quite accurately.

The refrigeration load is based on the hours indicated and on the outside air wet-and dry-bulb temperature records. The kilowatt-input is based on a single centrifugal refrigeration compressor using a cooling tower. The refrigeration tonnages include full sun heat, but allowance has been made for cloudy and short days when outside temperatures are below 60 F wet bulb. The temperature at y indicates the change-over point from refrigeration to heat for a primary cold air supply temperature of 55 F and line x indicates the same for a supply temperature of 50 F. When the sun is not shining, the change-over point y on the single-duct primary system can be moved to 42 F outside air dry-bulb temperature, and this is considered in determining operating hours.

The daytime heat requirements are based on outside dry-bulb temperature with no assistance from the sun, and the base scale is so arranged as to indicate the progressive transition from the cooling to the heating cycle. The diagonal line with the broken line extension is the heating load with the minimum ventilation specified, whereas the solid line extension is the actual heat used for additional outside air employed to permit the earliest possible shutdown of the refrigeration plant. The continuation of the refrigeration or heat demand lines beyond the change-over point merely shows the trend of these curves and is not included in the calculations.

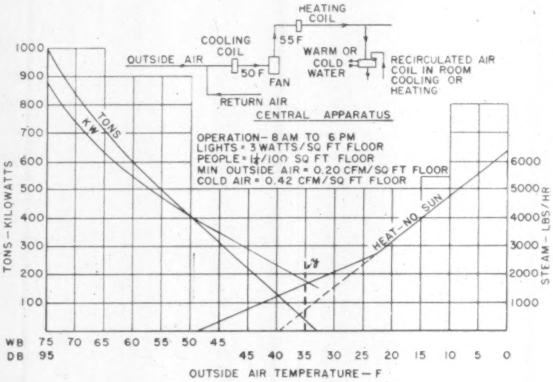

Fig. 10—Single-duct primary system—office building with 1000 tons — 305,000 sq ft floor area = 0.00328 tons per sq ft of floor

For the dual-duct one-fan system (Fig. 11) the outside air volume which is large at x could be reduced so that refrigeration could continue along its extension from x and the heat requirements would be cut back to the same point; thus there is no need for both heat and refrigeration at the same time under these average load conditions, but in practice a small amount of reheat must be available for room variations and for heat load shifts for any system. It may be noted that with the dual-duct two-fan system there is an interval when neither refrigeration nor heat is indicated.

For winter nights and holidays, or idle hours, it is assumed that ventilation will be reduced to actual infiltration and that a night temperature of 65 F is maintained. The heat requirements at these periods are the same for each of these systems.

The distribution of heat in an unoccupied building varies, but it is recognized that full operation of the air handling system is unnecessary and undesirable with any system. Reduced operation can be achieved in most winter weather conditions by reducing primary fan speed or by operation of the return air fan only in dual-duct systems and by hot water circulation in the single-duct primary or in any system with room secondary conditioning units or radiators.

Operating Costs

The analysis of annual operating cost, Table 2, is based on an installation requiring a 1000-ton refrigeration plant, for convenience and because refrigeration capacity is a fairly good index for similar systems in different buildings. A central station or any other system, however, using 100 percent outside air at temperature extremes, would require a refrigeration plant of 1550 tons and a heating plant capacity about twice that of the systems analyzed in Table 2 for Building 1, even if the air volume is throttled 25 percent in winter.

The total of hours of operation of the refrigerating equipment emphasizes the advantage of flexible and free use of outside air and the large primary air supply capacity of the dual-duct systems. The operating costs of power are based on a uniform 2 cents per kwhr rate, whereas the longer operating period of the single-duct primary system would increase the demand charge influence and raise the mean rate in the extended period of low refrigeration usage. This would increase the power cost of the single-duct primary system slightly.

The air conditioning systems are considered to operate fully 10 hr daily for 260 days. When the building is not occupied, operation is reduced to the minimum heating needs of transmission and infiltration losses. Heat is distributed by the return air fan of the dual-duct systems and by the hot water pumps of the single-duct primary system.

The occupied and unoccupied periods are separated and subdivided, so that costs for different conditions can be estimated. If steam is used for a turbine-driven centrifugal refrigerating unit, a steam rate of 16 lb per hp-hr and $1.00 per 1000 lb would equal the cost of the motor driven unit at 2 cents per kwhr. Any steam system, however, would increase the size and operating cost of the cooling tower.

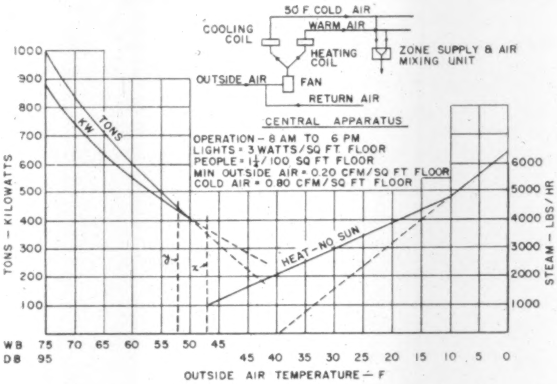

Fig. 11—Dual-duct one-fan system — office building with same load as Fig. 10

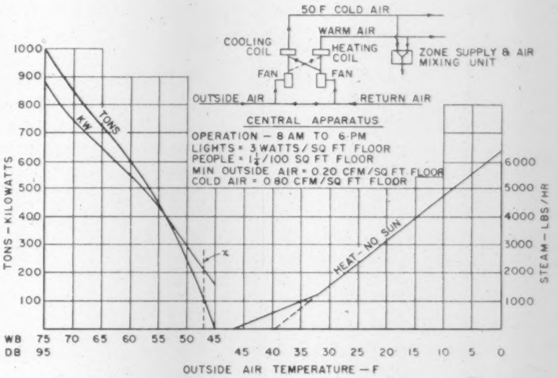

Fig. 12—Dual-duct two-fan system — office building with same load as Fig. 10

Static pressures on the supply fans are assumed to be 8 in. for the single-duct primary and 6 in. for the dual-duct systems. All return fans are figured for 2 in. static and all pumps for 100 ft head. These values are believed representative.

The total annual power, steam and water costs show the dual-duct two-fan system to be lowest, with a maximum difference of under 10 percent. The unit values are indicated in Table 1, Lines 21 and 22.

To the annual operating costs of Tables 1 and 2 must be added other charges. The initial investment cost of air conditioning equipment alone, exclusive of building changes, foundations, electric power, steam, water and sewer facilities, is about $800 to $1200 per ton of refrigeration capacity, with the dual-duct one-fan system generally lower than the single-duct primary system when designed specifically for the respective systems. The fixed charges on this investment at 6 percent interest and 15-year depreciation with no salvage value equals 10 percent or $80 to $120 per ton annually.

The single-duct primary system duct and piping system when used on the building periphery and in combination with a central station system for the interior zones will occupy about 2.5 percent of the building floor area. The dual-duct one-fan system when applied to both periphery and interior zones will require about 3 percent of the floor area for its installation. The average value of this space, including basement, is about $3.00 per sq ft. Maintenance and operating supervision for the single-duct primary system is estimated at about 25 percent higher than for the dual-duct system to allow for additional cleaning of the coils and boxes of the 500 to 600 room units, for servicing water valves and for shifting the secondary water from heating to cooling to meet seasonal and daily midseasonal load changes. The total annual fixed charges are about 2.5 times the power, steam and water costs.

APPENDIX

Determination of relative humidity in rooms conditioned by dual-duct one-fan system:

$$G_x = [G_c\ (1 - P_w) + G_o P_w P_o + G_r] \div [1 - P_w\ (1 - P_o)]$$

$$G_w = G_x + P_o\ (G_o - G_x)$$

$$P_w = (t_s - t_c)/(t_w - t_c),$$ for sensible heat balance

$$P_w = (G_x - G_c - G_r) \div [G_x - G_c + P_o\ (G_o - G_x)],$$ for grains moisture balance

$$t_w = [t_s - t_c\ (1 - P_w)]/P_w$$

G_x = moisture in return air, grains per pound.
G_c = moisture in cold air supply, grains per pound.
G_o = moisture in outside air entering mixing chamber, grains per pound.
G_w = moisture in warm air supply, grains per pound.
G_r = moisture load in room, grains per pound of supply air.
P_w = warm air, percent of supply.
P_o = outside air, percent of supply.
t_c = cold air supply temperature.
t_w = warm air supply temperature.
t_s = room supply temperature.

power consumption. These curves include the progressive changes in heat transmission through walls, ventilation loads and use of extra outside air where advantageous. When the duration of outside temperatures for the various hours of the day, throughout the year, is found from New York City weather records, and the increments of load for each temperature are known, the cumulative power and heat requirements can be determined quite accurately.

The refrigeration load is based on the hours indicated and on the outside air wet-and dry-bulb temperature records. The kilowatt-input is based on a single centrifugal refrigeration compressor using a cooling tower. The refrigeration tonnages include full sun heat, but allowance has been made for cloudy and short days when outside temperatures are below 60 F wet bulb. The temperature at *y* indicates the change-over point from refrigeration to heat for a primary cold air supply temperature of 55 F and line *x* indicates the same for a supply temperature of 50 F. When the sun is not shining, the change-over point *y* on the single-duct primary system can be moved to 42 F outside air dry-bulb temperature, and this is considered in determining operating hours.

The daytime heat requirements are based on outside dry-bulb temperature with no assistance from the sun, and the base scale is so arranged as to indicate the progressive transition from the cooling to the heating cycle. The diagonal line with the broken line extension is the heating load with the minimum ventilation specified, whereas the solid line extension is the actual heat used for additional outside air employed to permit the earliest possible shutdown of the refrigeration plant. The continuation of the refrigeration or heat demand lines beyond the change-over point merely shows the trend of these curves and is not included in the calculations.

For the dual-duct one-fan system (Fig. 11) the outside air volume which is large at *x* could be reduced so that refrigeration could continue along its extension from *x* and the heat requirements would be cut back to the same point; thus there is no need for both heat and refrigeration at the same time under these average load conditions, but in practice a small amount of reheat must be available for room variations and for heat load shifts for any system. It may be noted that with the dual-duct two-fan system there is an interval when neither refrigeration nor heat is indicated.

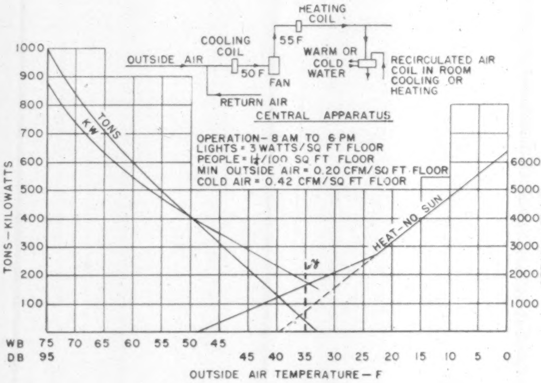

Fig. 10—Single-duct primary system—office building with 1000 tons — 305,000 sq ft floor area = 0.00328 tons per sq ft of floor

For winter nights and holidays, or idle hours, it is assumed that ventilation will be reduced to actual infiltration and that a night temperature of 65 F is maintained. The heat requirements at these periods are the same for each of these systems.

The distribution of heat in an unoccupied building varies, but it is recognized that full operation of the air handling system is unnecessary and undesirable with any system. Reduced operation can be achieved in most winter weather conditions by reducing primary fan speed or by operation of the return air fan only in dual-duct systems and by hot water circulation in the single-duct primary or in any system with room secondary conditioning units or radiators.

Operating Costs

The analysis of annual operating cost, Table 2, is based on an installation requiring a 1000-ton refrigeration plant, for convenience and because refrigeration capacity is a fairly good index for similar systems in different buildings. A central station or any other system, however, using 100 percent outside air at temperature extremes, would require a refrigeration plant of 1550 tons and a heating plant capacity about twice that of the systems analyzed in Table 2 for Building 1, even if the air volume is throttled 25 percent in winter.

The total of hours of operation of the refrigerating equipment emphasizes the advantage of flexible and free use of outside air and the large primary air supply capacity of the dual-duct systems. The operating costs of power are based on a uniform 2 cents per kwhr rate, whereas the longer operating period of the single-duct primary system would increase the demand charge influence and raise the mean rate in the extended period of low refrigeration usage. This would increase the power cost of the single-duct primary system slightly.

The air conditioning systems are considered to operate fully 10 hr daily for 260 days. When the building is not occupied, operation is reduced to the minimum heating needs of transmission and infiltration losses. Heat is distributed by the return air fan of the dual-duct systems and by the hot water pumps of the single-duct primary system.

The occupied and unoccupied periods are separated and subdivided, so that costs for different conditions can be estimated. If steam is used for a turbine-driven centrifugal refrigerating unit, a steam rate of 16 lb per hp-hr and $1.00 per 1000 lb would equal the cost of the motor driven unit at 2 cents per kwhr. Any steam system, however, would increase the size and operating cost of the cooling tower.

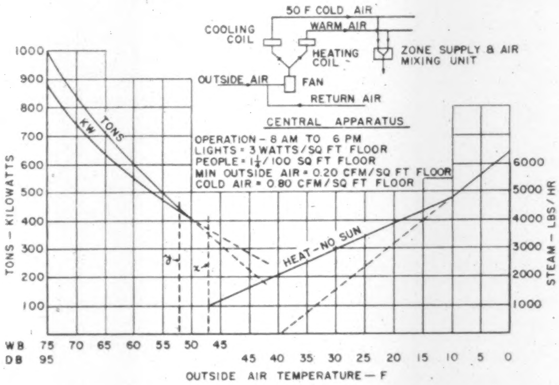

Fig. 11—Dual-duct one-fan system — office building with same load as Fig. 10

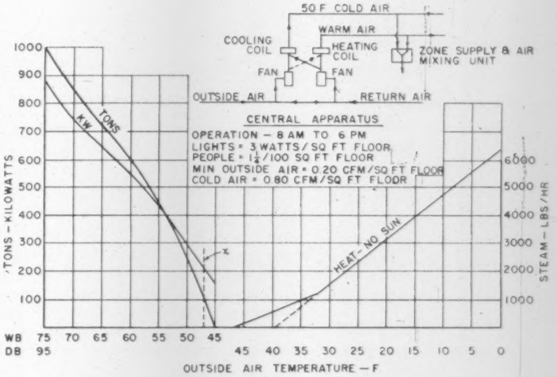

Fig. 12—Dual-duct two-fan system — office building with same load as Fig. 10

Static pressures on the supply fans are assumed to be 8 in. for the single-duct primary and 6 in. for the dual-duct systems. All return fans are figured for 2 in. static and all pumps for 100 ft head. These values are believed representative.

The total annual power, steam and water costs show the dual-duct two-fan system to be lowest, with a maximum difference of under 10 percent. The unit values are indicated in Table 1, Lines 21 and 22.

To the annual operating costs of Tables 1 and 2 must be added other charges. The initial investment cost of air conditioning equipment alone, exclusive of building changes, foundations, electric power, steam, water and sewer facilities, is about $800 to $1200 per ton of refrigeration capacity, with the dual-duct one-fan system generally lower than the single-duct primary system when designed specifically for the respective systems. The fixed charges on this investment at 6 percent interest and 15-year depreciation with no salvage value equals 10 percent or $80 to $120 per ton annually.

The single-duct primary system duct and piping system when used on the building periphery and in combination with a central station system for the interior zones will occupy about 2.5 percent of the building floor area. The dual-duct one-fan system when applied to both periphery and interior zones will require about 3 percent of the floor area for its installation. The average value of this space, including basement, is about $3.00 per sq ft. Maintenance and operating supervision for the single-duct primary system is estimated at about 25 percent higher than for the dual-duct system to allow for additional cleaning of the coils and boxes of the 500 to 600 room units, for servicing water valves and for shifting the secondary water from heating to cooling to meet seasonal and daily midseasonal load changes. The total annual fixed charges are about 2.5 times the power, steam and water costs.

APPENDIX

Determination of relative humidity in rooms conditioned by dual-duct one-fan system:

$$G_x = [G_c\,(1 - P_w) + G_oP_wP_o + G_r] \div [1 - P_w\,(1 - P_o)]$$

$$G_w = G_x + P_o\,(G_o - G_x)$$

$$P_w = (t_s - t_c)/(t_w - t_c),\ \text{for sensible heat balance}$$

$$P_w = (G_x - G_c - G_r) \div [G_x - G_c + P_o\,(G_o - G_x)],\ \text{for grains moisture balance}$$

$$t_w = [t_s - t_c\,(1 - P_w)]/P_w$$

G_x = moisture in return air, grains per pound.

G_c = moisture in cold air supply, grains per pound.

G_o = moisture in outside air entering mixing chamber, grains per pound.

G_w = moisture in warm air supply, grains per pound.

G_r = moisture load in room, grains per pound of supply air.

P_w = warm air, percent of supply.

P_o = outside air, percent of supply.

t_c = cold air supply temperature.

t_w = warm air supply temperature.

t_s = room supply temperature.

JOURNAL SECTION

Hot Water and Steam Heating Research

By John W. James*, Chicago, Ill.

DURING the early twenties, the attention of Society research was directed toward the determination of proper steam and condensate return pipe sizes, which resulted in capacity tables that have formed the basis of engineering design. In the intervening years, some research was sponsored on flow of water, but not until 1950 did the Society again actively pursue research in the fields of hot water and steam heating. Currently, research in this field covers three general categories.

Noise in Piping Systems: Before substantial progress could be made in this investigation under a cooperative arrangement at Northwestern University, it was necessary to establish fundamental techniques for measuring comparative results. At the June 1954 Semi-Annual meeting of the Society held in Swampscott, the second research report covering this project indicated that elbows, valves and orifices are all much more potent noise sources than straight runs of pipe. Work now in progress will gather information on larger pipe sizes and endeavor to evaluate noise produced by pumps.

Venting Hot Water Heating Systems: Early this year, another cooperative research project was initiated at the University of Illinois to study how dissolved gases are separated from water in a laboratory setup of an actual system. By the use of glass sections in the piping system, it will be possible to study the entrainment of gas by water as it moves through the piping system. It is hoped that with a better understanding of the problem, it may be possible to design systems which will permit separation of gases from water at a single point and also provide means of removing gases from the distribution system before they interfere with circulation or create noise.

Metastable State in Heating Boilers: It is recognized that water exists in a metastable state when its temperature is above the normal boiling temperature for the pressure existing. Steam should have occurred, but has not. A disturbing influence, such as vibration, surface roughness, increase in flow rate, or mixing could suddenly cause the water to return to normal equilibrium with a rapid increase in volume caused by sudden flashing. It is felt from experimental work already accomplished, through cooperative research at Northwestern University, that this rapid volume increase can result in momentary high pressures which can produce excessive inertia forces in various regions of a pressure vessel, such as a boiler.

Other Committee discussions have involved the analysis of a method for properly sizing expansion tanks, which resulted in a paper presented at the Society's 59th Annual Meeting in Chicago, January 1953. Currently, attention is being directed toward recommendations for flow and return piping connections to hot water heating boilers and an analysis of snow melting design procedures.

Since the present Technical Advisory Committee was formed in September of 1950, twelve meetings have been held in which the following members have taken an active part in formulating plans for the several research projects initiated by this group: R. C. Chewning, Portland, Ore.; H. C. Day, Pittsburgh; W. S. Harris, Urbana, Ill.; L. N. Hunter, Johnstown, Pa.; John W. James, Chicago; A. T. Jones, Toronto, Canada; H. A. Lockhart, Morton Grove, Ill.; M. W. McRae, Chicago; N. D. Skinner, Indianapolis; S. K. Smith, Westfield, Mass.; Benjamin Spieth, Racine, Wis.; and M. H. Westerberg, Chicago.

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*Chairman, ASHVE Technical Advisory Committee on Hot Water and Steam Heating.

Ventilation of Commercial Laundries

By Sidney Marlow*, New York, N.Y.

SUMMARY — Laundry ventilation is used to control the heat and moisture released to the workroom. Flatwork ironers are best ventilated by means of local exhaust; washers and press units can, at best, be ventilated by general ventilation. Exhaust volumes have been calculated by means of material and heat balances around ideal systems; these exhaust rates have been tabulated for washers, presses and ironers, and may be used with an appropriate safety factor in estimating the amount of ventilation required in a laundry.

THE COMMERCIAL laundry has always been confronted with the problem of heat and moisture removal from the workroom. Ventilation must be provided to keep temperature and humidity within limits considered safe for workers. The main pieces of laundry equipment which subject the workroom environment to high temperature and humidity are the flatwork ironers, washers and presses.

Flatwork Ironers

A canopy hood located over the rolls has been found to be the most practicable means for ventilating flatwork ironers. Several such hoods are commercially available. They usually have hinged side panels with closely spaced glass panes (Fig. 1). Hinged panels make possible easy access to the ironer for repadding rolls, inspection and maintenance. Where feasible, the bottom edge of the hood should be placed flush with the top of the sides of the ironer. In this way, air need be exhausted only through the working openings at the ends of the ironer.

Two factors must be considered in determining the rate of ventilation for canopy exhaust. First, a minimum control velocity must be maintained at all the openings between the bottom edge of the hood and the top edge of the machine. This velocity is essentially the minimum capture velocity for steam vapor and may be fixed as 50 fpm. Secondly, we may safely assume that the hood and duct will approach the temperature of the exhausted air passing through it. The temperature of the exhausted air should, therefore, be limited to a temperature of 125 F to minimize heat transfer back to the workroom, as well as to make the hood safe to touch.

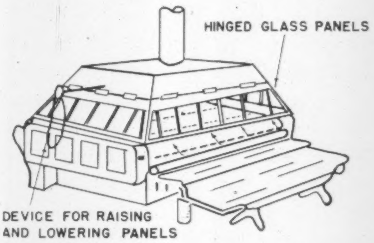

Fig. 1—Canopy hood for flatwork ironer

By means of heat balances, it is possible to estimate the exhaust volume necessary to meet the two given requirements. In determining the heat load which must be dissipated, only the sensible portion of the delivered boiler horsepower must be considered. From Table 1, it will be seen that about 65 percent of the rated delivered boiler horsepower is sensible heat.

$$Q = 794\ (\text{bhp}) \quad \ldots\ldots\ldots\ldots(1)$$

giving the ventilation rate Q in cubic feet per minute as a function of the rated flatwork ironer boiler horsepower (bhp) is derived in the Appendix. The most common flatwork ironers and the ventilation rates as calculated from Equation 1 are shown in Table 1, Column 5.

In determining the ventilation rate it is necessary to compare the ventilation rate based upon 50 cfm per square foot of net opening with that shown in Table 1 and then to select the greater of the two. For example, canopy hoods similar to that shown in Fig. 1 are to be used for a 2-roll-120 in. and an 8-roll-120 in. flatwork ironer. The sides of the canopy hood are flush with the top side pieces of the ironer leaving, we may assume, net working openings at each end 12 × 1 ft, or a total of 24 sq ft for both sides. From Table 1, the ventilation rates are 3000 and 11,000 cfm respectively for the 2-roll-120 in. and 8-roll-120 in. ironers. Since these rates exceed the 1200 cfm required to maintain the minimum 50 fpm control velocity, the ventilation rates from Table 1 are satisfactory. On the other hand, if the net working openings were 12 × 3 ft, a ventilation rate of 3600 cfm for the 2-roll ironer would be required to maintain the minimum 50 fpm control velocity.

In addition to ventilating the ironer, the hood also provides protection for the padded rolls and chests from dust and lint and is a safety guard.

Washers

The problem of determining the amount of ventilation required for workrooms where washers are located is complicated by the lack of available data involving heat losses through the washer shells. In addition, the washers are operated through a definite cycle where the water changes are rather frequent. The washer water temperatures will vary from cold to hot, the exact temperatures depending upon the washing formula being used. The maximum temperature encountered in practically all washers is 180 F and is used only during the rinsing operations. Furthermore, the effective area of the washer shell through which the heat is transmitted to the surrounding air is practically indeterminate. All these factors make it difficult to obtain ventilation rates with any degree of accuracy.

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*Industrial Hygiene Engineer, Division of Industrial Hygiene, New York State Department of Labor.

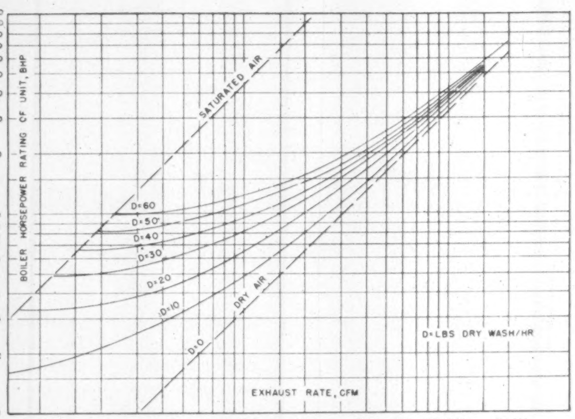
At best, ventilation rates may be estimated by assuming an average surface shell temperature of 160 F and an overall heat transfer coefficient of 3.0 Btu per (hr) (sq ft) (F deg) for a metal shell. The effective area of heat transfer may be considered to be the surface of the cylinder. Washers are nominally specified in terms of the cylinder diameter and length; the cylinder surface area is thus easily obtainable.

The expression derived in the Appendix gives the ventilation rate Q in cubic feet per minute as a function of the nominal length N and diameter d (both in inches) of a metal washer as

$$Q = 0.39d\,[N + (d/2)] \quad \ldots\ldots(2)$$

A list of the various size washers with the exhaust volumes as calculated from Equation 2 is given in Table 2.

The exhaust rates for washers in Table 2 have been based upon maintenance of a maximum dry-bulb temperature of 100 F in the workroom. In many plants the spent wash water is dumped directly on the floor and is disposed of through floor drains. On the floor the water presents a large water to air interface; this probably makes the humidity rather than the dry-bulb temperature the controlling factor in determining the amount of ventilation. Since there is no means of estimating the amount of moisture being transferred to the air, it is suggested that the exhaust volumes in Table 2 be multiplied by a factor of two in determining the ventilation rate of washrooms where such practices exist.



Air entering workroom assumed to be at a dry-bulb temperature of 90 F and a wet-bulb temperature of 75 F. Dry-bulb temperature limited to 100 F; 10 F rise in dry-bulb temperature

Fig. 2—Exhaust rate *vs.* rated boiler horsepower of press unit

For corresponding size wood washers, the washer overall heat transfer coefficient may be assumed to be one-fourth the value for metal washers. Therefore, for wood washers of the same size as indicated in Table 2, 25 percent of the exhaust volume listed in Table 2 should be used.

Presses

The use of local exhaust ventilation as a means of heat and moisture removal from shirt and garment presses is not practicable because of the nature of the pressing operation. A method of general room ventila-

Table 2—General Ventilation Rates for Metal Washers

Nominal Size Inches	Ventilation Rate, Cfm
24 x 24	340
24 x 36	450
30 x 30	530
30 x 36	600
30 x 48	740
36 x 36	760
36 x 54	1000
36 x 64	1200
42 x 36	940
42 x 54	1200
42 x 64	1400
42 x 72	1500
42 x 84	1700
42 x 96	1900
44 x 36	1000
44 x 54	1300
44 x 60	1400
44 x 72	1600
44 x 84	1800
44 x 96	2000
44 x 108	2200
44 x 120	2400
54 x 84	2300
54 x 96	2600
54 x 108	2900
54 x 120	3100

Note: Use 25 percent of the Cfm rates for corresponding wood washers.

Table 1—Sensible Heat Loads and Minimum Ventilation Rates for Flatwork Ironers

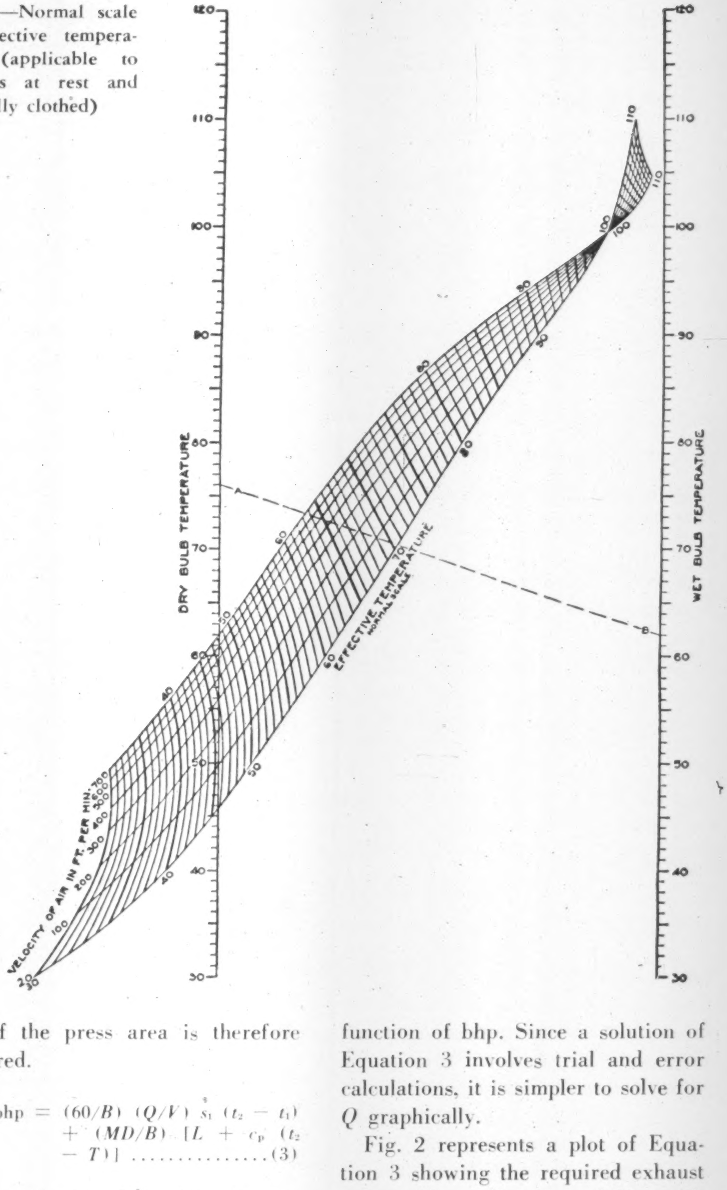
Column No.	1	2	3	4	5
Ironer Inches	Rated[a] Boiler Hp Bhp	Approx.[b] Production lb/hr	Latent Bhp	Percent Rated Bhp Sensible	Minimum[c] Ventilation Rate Cfm
2-Roll-100	3.1	75-85	1.2	66	2500
2-Roll-120	3.8				3000
4-Roll-100	6.3	150-165	2.3	67	5000
4-Roll-110	6.8				5400
4-Roll-120	7.6				6000
6-Roll-100	9.0	225-250	3.5	65	7100
6-Roll-110	9.9				7900
6-Roll-120	10.7				8500
8-Roll-100	12.8	300-330	4.6	66	10,000
8-Roll-120	14.2				11,000
12-Roll-120					15,000

[a] Determination of Laundry Power Plant Requirements, Special Report No. 146. Bhp ratings taken from Table 4, p. 16 (*American Institute of Laundering*, Joliet, Ill.).

[b] Wearing apparel and flat work.

[c] Calculated by Formula − Cfm = 794 (bhp) = 794 × Column 1.

Fig. 3—Normal scale of effective temperature (applicable to persons at rest and normally clothed)



tion of the press area is therefore preferred.

$$\text{bhp} = (60/B)\ (Q/V)\ \overset{s}{s}_1\ (t_2 - t_1) + (MD/B)\ [L + c_p\ (t_2 - T)] \quad \ldots\ldots\ldots\ldots\ldots (3)$$

is the expression derived in the Appendix and in terms shown under Nomenclature, giving the ventilation rate, Q, for presses as an implicit function of bhp. Since a solution of Equation 3 involves trial and error calculations, it is simpler to solve for Q graphically.

Fig. 2 represents a plot of Equation 3 showing the required exhaust volume Q as a function of the maximum boiler horsepower of a unit handling an average of D pounds of dry clothing per hour. The straight line labeled *Saturated air* represents moisture saturation of the air at the maximum production rate D.

Table 4—Boiler Horsepower (Bhp) Ratings for Apparel Presses

Apparel Presses	Assigned Bhp	Approximate Size of Buck, Inches
Coverall Body Press	0.75	33 x 16 x 13
Mushroom Press	0.37	18 x 10
Mushroom Press, Tapered	0.47	21 x 12
Apparel Press, Rectangular	1.9	53 x 18
Apparel Press, Tapered	1.9	50 x 17 x 9

A survey of several of the large New York metropolitan commercial laundries revealed that the representative production rate for shirt pressing units may be taken as 12 lb of dry wash per operator per hour. However, two commercial units, one of which incorporated a double bosom press, were able to produce as much as 15 lb per operator per hour. It was also found that a production rate of 12 lb per operator per hour is representative for general apparel pressing units where one operator is assigned to each general apparel unit.

The determination of the maximum boiler horsepower consumed by the various press units would require calorimetric measurements of the steam at the press inlet and outlet as well as weighing the condensate over a definite period of time. For the same type of unit this value would, in all probability, vary from plant to plant, depending upon the condition of the steam being fed to the press, the nature of production, and the design and type of bucks used in the presses. For the purpose of assigning a definite maximum boiler horsepower rating to the various type presses commonly used, the manufacturers rated boiler horsepower of the various presses were tabulated and a representative rating selected for each type press as shown in Tables 3 and 4.

A list of practically all the various types of units used with recom-

Table 3—Boiler Horsepower (Bph) Ratings for Shirt Unit Presses

Shirt Unit Presses	Assigned Bhp	Approximate Size of Buck Inches.
Body Press	1.0	35 x 20 x 12
Bosom Press	1.5	40 x 18 x 11
Combination Bosom and Body Press	1.5	40 x 18 x 11
Collar and Cuff Press	0.75	20 x 6, 10 x 7
Cuff and Gusset Press (Double Cuff Press)	0.75	8 x 8 x 4
Double Collar Press	0.75	20 x 8 each
Double Sleeve Press	0.75	23 x 11
Double Sleeve Form	0.25	- - - - - - - -
One Lay Double Sleeve Press	0.54	24
Single Collar Press	0.30	20 x 7
Two Lay Sleeve Press	0.27	24
Yoke Press	0.32	20 x 11

mended exhaust rates is given in Tables 5 and 6. Since one operator is assigned to an apparel unit, the average production rate of 12 lb per operator per hour applies for the unit. For combinations of presses comprising units not listed, the exhaust volume may be obtained by determining the maximum unit boiler horsepower and production rate and using Fig. 2.

In order to increase the productive capacity of flatwork ironers, some laundries *precondition* the extracted wash before sending it to the ironers. The extracted wash is dried in a heated tumbler ventilated to the outside usually to a moisture content less than 0.1 lb of water per pound of dry wash. With such a low moisture content, the wash can be passed through the rolls at a much faster rate increasing the productive capacity of the ironer. If the productive capacity of the ironer is increased in the same proportion as the decrease in moisture content of the *preconditioned wash*, Equation 3 remains unchanged. The exhaust volume for the prescribed conditions is, therefore, seen to be a function only of the rate of moisture evaporated, *MD*.

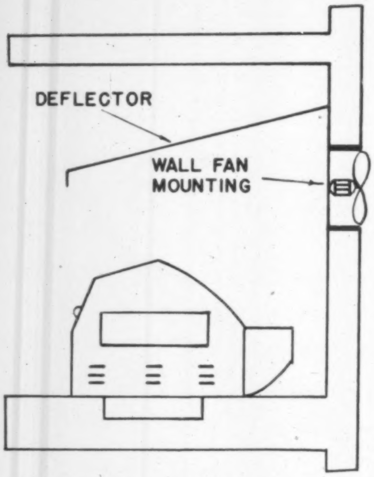


Fig. 4—Ventilation of washers; wall fan mounting

In the case of flatwork ironers general ventilation might be considered as an alternative to local exhaust ventilation. Consider a typical 2-roll-120 in. and an 8-roll-120 in. ironer rated at 3.8 and 14.2 bhp, respectively. For family flatwork with net identification, the production usually obtained from each of the above ironers would approximate 100 lb per hour for the 2-roll ironer and 400 lb per hour for the 8-roll ironer. The exhaust volumes from Equation 3 for each of these ironers are 6400 and 20,000 cfm respectively.

If canopy exhaust hoods are used with each of these ironers, minimum local exhaust rates of 3000 and 11,000 cfm (Table 1) are required. Assuming these rates exceed those based upon 50 cfm per square foot

Table 5—General Ventilation Rates for Shirt Pressing Units

Presses Comprising Unit	Operators	Production lb/hr	Maximum Unit, Bhp	Exhaust Rate Cfm
1. Collar & Cuff Combination-Bosom and Body Two Lay Sleeve	2	24	2.52	6200
2. Collar & Cuff Yoke Bosom Double Sleeve Form	3	36	2.82	6600
3. Collar & Cuff Yoke Bosom Two Lay Sleeve	3	36	2.84	6600
4. Collar & Cuff Yoke Combination-Bosom and Body Two Lay Sleeve	2	24	2.84	7000
5. Collar & Cuff Bosom Body Double Sleeve Form	3	24	3.50	9000
6. Double Cuff & Gusset Single Collar Yoke Combination-Bosom and Body Double Sleeve Double Sleeve Form	4	60[a]	3.87	9000
7. Two Lay Sleeve (2) Collar and Cuff Yoke Body Bosom	4	48	4.11	10,000
8. Double Sleeve Yoke Combination-Bosom and Body Body Single Collar Double Cuff Double Sleeve Form	4	48	4.12	10,000
9. Yoke Body Bosom Collar and Cuff One Lay Double Sleeve	3	36	4.11	11,000
10. Two Lay Sleeve (2) Collar and Cuff Yoke Body Bosom	3	36	4.11	11,000
11. Combination-Bosom & Body Body Double Cuff Collar & Cuff Yoke Double Sleeve Form	4	48	4.57	12,000
12. Two Lay Sleeve (2) Double Collar Body Bosom Yoke Double Cuff	4	48	4.86	12,500
13. Two Lay Sleeve (2) Combination-Bosom and Body Double Cuff Double Sleeve Yoke Body	4	48	4.86	12,500
14. Double Sleeve Double Cuff & Gusset Single Collar Body Double Sleeve Form Double Bosom (Tiltor)	4	60[a]	6.05	16,000

[a] High production, 15 lb/operator per hr. Average production, 12 lb/operator per hr.

of net opening, it is quite obvious that general ventilation requirements for ironers will be approximately twice as great as the local exhaust rates listed in Table 1.

In determining the actual design exhaust volumes, it is necessary to consider several factors present in the workroom affecting the removal of heat by the exhausted air. A non-uniform airflow distribution caused by obstructions located between the fan and the presses, the presence of washers near the press area, additional heat being generated by hand ironing, etc., must be evaluated in terms of a safety factor by which the minimum exhaust volume must be multiplied. It is usually not necessary to exceed a safety factor of two.

Effective Temperature

Effective temperature may conceivably be used as a basis for design instead of the dry-bulb temperature. Theoretically, this would be more desirable. The effective temperature for a given subject is a function of the air movement as well as the dry- and wet-bulb temperatures as shown in Fig. 3. A superficial air velocity would therefore have to be computed from the total exhaust volume and the size of the workroom. The heat load and the amount of moisture released to the workroom are fixed by the type of unit and its productive capacity. It would, therefore, be necessary to proceed by trial and error to choose an exhaust volume that is compatible with Equation 3 as well as with Fig. 3. Since this would be a lengthy procedure which is not warranted by the accuracy of the data describing the conditions in the workroom, it is not recommended.

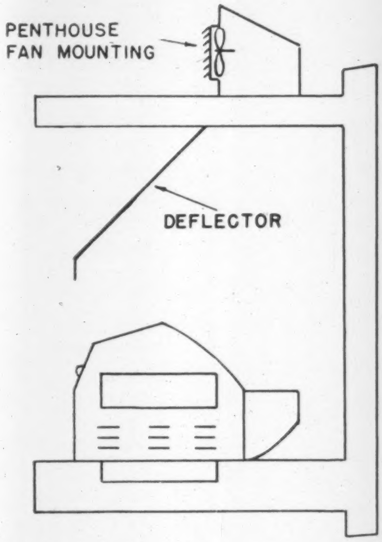


Fig. 5—Ventilation of washers; penthouse fan mounting

Fan Location

The location of the fan and the points of air make-up to the workroom are the two important factors influencing the direction and path of air movement within the workroom. Since it is common practice to have the flatwork finishing and washers located in separate sections, if not separate rooms, air movement must be directed in such a manner as to prevent the hot moist air from mixing with the general room air.

If washers are located in a line along an outside wall, a series of propeller fans mounted in the building wall or windows may be used as shown in Fig. 4. A number of small fans will distribute the air flow better than one large fan. A deflector located above the washers will also improve the air flow pattern. It is also desirable to use outside baffles to prevent the wind from adversely affecting the capacity of the fans. When direct discharge would create a nuisance, stacks discharging above the roof should be provided. If the outside wall is next to an adjacent building or if the washers are located next to an interior partition, air must be exhausted through the roof as shown in Fig. 5. If washers are not located near walls, roof ventilators located above the washer and discharging through the roof are satisfactory.

Press areas may be ventilated in the same manner as the washers. Exhaust fans can be mounted in windows of the walls close to the presses with the bottom of the fans approximately even with the top of the presses. Where this type of exhaust arrangement is not possible, an overhead duct exhaust system with grilled openings located above

Table 6—General Ventilation Rates for Apparel Pressing Units

Presses Comprising Unit	Maximum Unit Bhp	Exhaust Rate Cfm
1. Tapered Apparel	1.9	5,200
2. Tapered Apparel Yoke	2.22	6,200
3. Tapered Apparel Mushroom	2.27	6,200
4. Coverall Body (3)	2.25	6,200
5. Tapered or rectangular Apparel Mushroom (2)	2.64	7,400
6. Rectangular Apparel (2) Yoke	4.12	12,000
7. Tapered Apparel (2) Yoke	4.12	12,000
8. Tapered Apparel (2) Mushroom	4.17	12,000
9. Rectangular Apparel (3)	5.70	16,000

Note: Average production, 12 lb/hr. One operator per unit.

Table 7—Ventilation Requirements for a Typical Laundry

Laundry Equipment Inches		Design Exhaust Rates	Fan Locations & Specifications
Washers	42 x 36	940	Install 3 fans at window locations A,C,D, each capable of exhausting 900 CFM; at location B, 1200 CFM; at E, 1700 CFM.
	42 x 54	1200	
	42 x 84	1700	
	42 x 84	1700	
	Total:	5540 CFM	5600 CFM
Ironers	1-120″ 6-Roll Local exhaust	8500 CFM (Table 1)	Install canopy hood (Fig. 1). Duct fan for canopy exhaust selected to exhaust 5200 CFM at system resistance.
Presses	1-4 girl shirt unit (#11 from Table 5)	12,000 CFM	Install at window location F, fan capable of exhausting 9,000 CFM; at window of location G, 3,000 CFM. (Total: 12,000 CFM)
	5-Apparel press units (#5 from Table 6)	37,000 CFM (7400 CFM per unit)	Install at window locations, H,I,J,K, 4 fans each capable of exhausting 10,000 CFM (Total: 40,000 CFM)
	Total:	49,000 CFM	52,000 CFM

4

the press units has been used effectively.

In order to control air movement and prevent *contamination* of make-up air entering the workroom, make-up air inlets should be located between the press and washer areas. The simplest method of doing this, for a one-story building, is through skylight vents located in the roof. This must be taken into account in the choice and in the design of buildings to be used for laundries.

The ventilation rates given in Tables 5 and 6 have been based upon definite outdoor conditions, namely, a dry-bulb temperature of 90 F and a wet-bulb temperature of 75 F. Since the actual outdoor conditions will vary throughout the year, these rates can only be used as a basis for choosing the size and number of fans. The infrequent number of days encountered during the summer months in New York State which might impose more severe conditions does not warrant a more rigid basis. On the other hand, these exhaust rates are greater than actually required during the winter months. It is, therefore, necessary to proceed in the same manner as in air conditioning design; namely, to choose the equipment on the foregoing basis and to adjust the operation of equipment depending upon the outdoor conditions. Thermostatic controls, as used in air conditioning installations, are not warranted in the case of laundries; manual adjustment, by simply shutting off one or several of the fans is satisfactory. In this manner, sufficient flexibility is attained for proper operation throughout the entire year.

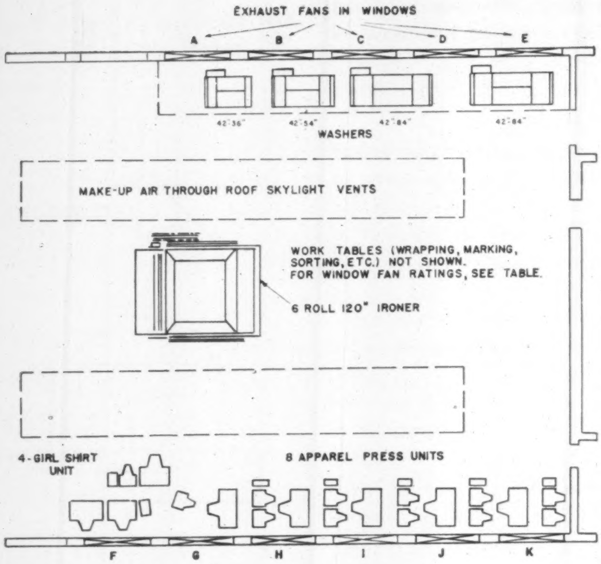

EXHAUST FANS IN WINDOWS
A
B
C
D
E
42"36"
42"54"
42"84"
42"84"
WASHERS
MAKE-UP AIR THROUGH ROOF SKYLIGHT VENTS
WORK TABLES (WRAPPING, MARKING, SORTING, ETC.) NOT SHOWN.
FOR WINDOW FAN RATINGS, SEE TABLE.
6 ROLL 120" IRONER
4-GIRL SHIRT UNIT
8 APPAREL PRESS UNITS
F
G
H
I
J
K

Fig. 6—Layout of washers, ironer and presses in a laundry showing location of fans and make-up air inlets

Ventilation in a Typical Commercial Laundry

To illustrate how these principles are applied, consider the typical commercial laundry shown in Fig. 6. The design requirements for this laundry are tabulated in Table 7.

APPENDIX

Flatwork Ironers

To estimate the ventilation rate which would limit the temperature of the exhausted air to 125 F, it is necessary to make a heat balance. Sensible heat is transferred from the ironer rolls to the flatwork and the air passing under the hood. As shown in Table 1, column 4, approximately 65 percent of the delivered bhp is sensible. The remainder of the delivered bhp is dissipated as latent heat in vaporizing the moisture from the entering flatwork.

To simplify calculations, we may assume an average heat capacity of 0.30 Btu per (lb) (F deg) and an average specific volume of 16.4 cu ft per lb for the moist heated air covering the range between 100 F and 125 F. The temperature of the wet flatwork entering the ironer may be considered to be at the wet-bulb temperature of the workroom air. The air entering the workroom is assumed to be at a dry-bulb temperature of 90 F and a wet-bulb temperature of 75 F. Since the temperature rise in the workroom is limited to 10 deg, the workroom wet-bulb temperature will be equal to 78 F. This temperature, t_1, will be considered the temperature of the flatwork entering the ironer. The temperature of the flatwork leaving the ironer, t_o, may be assumed to be equal to 150 F. The specific heat of the cotton flatwork, s_f, may be taken as 0.32 Btu per (lb) (F deg).

A heat balance of the sensible portion of the delivered bhp leads to the following expression:

$$0.65\,B\ [\text{Flatwork bhp}] = 60\,(Q/V)\,s_a\,\Delta t_2 + D s_f\,(t_o - t_1) \quad \text{(A-1)}$$

After substituting the appropriate values for the terms in Equation A-1 the following is obtained:

$$Q = 794\ (\text{bhp}) - 0.84\,D \quad \text{(A-2)}$$

The second term, 0.84 D, represents the amount by which the ventilation rate must be lowered to account for the heat transferred to and taken away by the flatwork. This term represents less than 3 percent of the ventilation rate and may therefore be neglected. The abbreviated Equation 1 is used to calculate the ventilation rates given in Table 1.

Washers

Consider a washer room completely isolated from the rest of the laundry. The make-up air temperature may be taken as 90 F. If we limit the temperature rise to 10 F, the change in specific enthalpy of the air (assumed to be dry) will be 2.40 Btu/lb. The foregoing assumptions make it possible to make a heat balance resulting in the following expressions:

$$Q = (Uv\,\Delta t_2)\,/\,(\Delta h \times 60) \quad \text{(A-3)}$$

Considering the surface of the cylinder to be the effective heat transfer area, we obtain

$$A_s = 0.0218\,d\,[N + (d/2)] \quad \text{(A-4)}$$

Combining Equations A-3 and A-4 and substituting the following numerical values, $U = 3.0$ Btu per (hr) (sq ft) (F deg), $\Delta t_2 = 60$ F, $v = 13.4$ cu ft per lb, $h = 2.4$ Btu per lb, the exhaust volume becomes a function of the nominal size of the washer as in Equation 2.

Presses

Consider an ideal situation where the presses which comprise a unit finishing a complete garment are isolated in a room separate from the other laundry equipment so that material and heat balances may be computed (Fig. A-1).

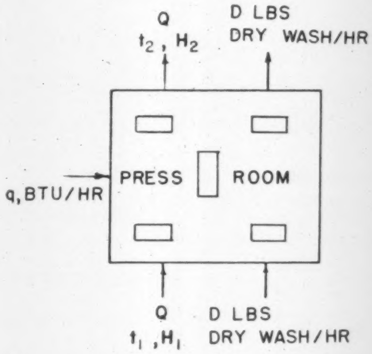


Fig. A-1—Heat and material balance around a press room

This system is analogous to a non-adiabatic humidifier with the moisture being added to the entering air from the wet clothes. A heat balance for the system gives

$$q = Gs_1\ (t_2 - t_1) + G\ (H_2 - H_1) \cdot [L + c_p\ (t_2 - T)] \ \ldots\ldots (A\text{-}5)$$

A material balance for the system gives:

$$G\ (H_2 - H_1) = MD \ \ldots\ldots\ldots\ldots (A\text{-}6)$$

Since

$$Q = (Gv/60) \ \ldots\ldots\ldots\ldots\ldots\ldots (A\text{-}7)$$

and

$$q = B\ (\text{bhp}) \ \ldots\ldots\ldots\ldots\ldots\ldots (A\text{-}8)$$

Equations A-5 and A-6 may be rewritten as in Equation 3 or these same equations may be further rewritten as

$$H_2 = H_1 + 0.223\ (MD/Q) \ \ldots (A\text{-}9)$$

For the computations which follow, the entering air is assumed to be at a dry-bulb temperature, t_1 equal to 90 F and a wet-bulb temperature, t_w equal to 75 F so that the absolute humidity, H_1, of the entering air as obtained from the humidity chart is equal to 0.0152 lb of water per pound of dry air.

In New York State, Industrial Code Bulletin No. 27 (the Laundry Code) does not permit the dry-bulb temperature in the workroom to exceed the outdoor dry-bulb temperature by more than 10 deg. Therefore, the limiting temperature in the workroom t_2 is assumed, in these calculations, as 100 F. The moisture content of clothing leaving the extractor and brought to the presses may be considered equal to 0.50 lb of water per pound of dry clothing. Actual measurements made at a local laundry substantiate this value.

By using D as a parameter and holding it constant, and assuming a series of values for Q, it is possible to solve for H_2 in Equation A-9 for various values of Q. Knowing H_2 and t_2, T can be obtained from the humidity chart and in turn L which varies with T. By substituting the values thus obtained Equation 3 can be solved for bhp. In this manner, a relationship between Q and bhp may be obtained with D as a parameter.

We may note that the ventilation rates for presses are based on the overall transfer of heat between the press room and the outside. Even though heat is transferred to the work, it is dissipated within the workroom so that the net effect is actually as depicted by Equation 3.

Nomenclature

A_s = effective surface heat transfer area of washer, square feet.
B = conversion factor, 33,500 Btu per hour (boiler horsepower).
bhp = rate of heat transfer from ironer and press units, boiler horsepower.
c_p = heat capacity of water vapor = 0.48 Btu per (pound) (Fahrenheit degree).
D = dry wash entering and leaving system, pounds per hour.
d = nominal diameter of cylinder of washers, inches.
G = dry air entering and leaving system, pounds per hour.
H_1 = absolute humidity of air entering system, pounds moisture per pound dry air.
H_2 = absolute humidity of air leaving system, pounds moisture per pound dry air.
Δh = change in specific enthalpy of dry air from t_1 to t_2, Btu per pound dry air.
L = latent heat of vaporization of moisture in clothing being pressed, Btu per pound moisture.
M = moisture content of clothing entering system, pounds moisture per pound dry wash.
N = nominal length of cylinder of washers, inches.
Q = ventilation rate, cubic feet per minute.
q = total heat transferred from presses comprising unit, Btu per hour.
s_a = average humid heat capacity of air between 100 F and 125 F = 0.30 Btu per pound humid air (F deg).
s_1 = humid heat capacity of outdoor air entering workroom = 0.245 Btu per pound dry air (F deg) at $t_1 = 90$ F and $t_w = 75$ F.
s_f = heat capacity of cotton flatwork = 0.32 Btu per (lb) (F deg).
T = wet-bulb temperature of air in workroom, Fahrenheit degrees.
t_i = temperature of flatwork entering ironer, Fahrenheit degrees.
t_o = temperature of flatwork leaving ironer = 150 F.
t_1 = dry-bulb temperature of air entering system, Fahrenheit degrees.
t_2 = dry-bulb temperature of air leaving system, Fahrenheit degrees.
t_w = wet-bulb temperature of air entering system, Fahrenheit degrees.
Δt_1 = maximum temperature rise of canopy exhaust air from flatwork ironer, Fahrenheit degrees.
Δt_2 = difference in temperature between shell of washer and surrounding air, Fahrenheit degrees.
U = washer overall heat transfer coefficient, Btu per (hour) (square foot) (Fahrenheit degree).
v = specific volume of air (at 70 F, $v = 13.4$ cu ft per lb).

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20 CHAPTERS VISITED BY SOCIETY OFFICERS

Pres. L. N. Hunter, 1st Vice Pres. J. E. Haines, 2nd Vice Pres. John W. James and Treas. E. R. Queer, collectively, attended approximately 20 local chapter meetings in October.

Speaking on *The Rating of Heating Boilers*, President Hunter visited 7 local chapters. They were Western New York, October 11, in Buffalo; Empire State meeting in Menands, October 13; Philadelphia Chapter, October 14; New York on October 18; Massachusetts meeting in Cambridge on October 19; Connecticut meeting in New Haven on October 21; and Central New York meeting in Syracuse on October 27.

The Ontario Chapter meeting in Toronto on October 4 was the first of six meetings attended by Vice President Haines. Other meetings attended were the Memphis Chapter, October 18; Delta Chapter meeting in New Orleans, October 19; Shreveport Chapter, October 21; Mississippi Chapter meeting in Jackson, October 25; and the Arkansas Chapter meeting in Little Rock, October 26.

Give The Public What They Need was the recommendation of Vice President James in visiting the Cincinnati Chapter, October 5; Miami Valley Chapter meeting in Dayton, October 6; and the Manitoba Chapter meeting, October 28 in Winnipeg.

Treas. E. R. Queer, discussed the *current and anticipated projects of the Society* while visiting the St. Louis Chapter on October 12. At the Baltimore Chapter meeting on October 20 he spoke of *Air Conditioning Caves For Storage.*

CURRENT ASHVE ACTIVITIES

DEAR MEMBERS:

The Fall of the year is always a time of considerable activity in our Society. The Society's officers visit many of our Chapters during the Fall months and most of our Chapters start their new Chapter year with meetings in September or October.

Starting shortly after Labor Day, many of our important Committees meet. The Finance Committee prepares a budget for the next fiscal year which started November 1 and submits it to Council for approval.

Budget for 1954-55 Fiscal Year

Council, at its October 8 meeting, approved a budget of $588,000 for this fiscal year. Of this total, $246,000 is for research. Last year our total budget was $493,545, of which $176,170 was for research.

This budget represents a yearly expenditure of more than $60 per member. We receive in dues from Members, Associates, and Affiliates $25 per year, of which $10 must be allocated to research, and $15 dues from Junior Members. The dues received average about $22 per member per year and the difference between this and the $60 per member we will spend must be made up through the sale of advertising, publications, and contributions from industry toward our research.

The dues paid by our members represent less than 40 percent of the amount the Society spends on services to its members, the industry, and the public.

The larger budget is due mainly to increased services that have been planned. The cost of services has been increasing and the problem of financing them becomes more critical each year. Curtailment of services at a time when our industry, which is becoming more technically complex, appears to be on the threshold of an expansion that is much greater than anything we have experienced in the past is unthinkable.

Research Promotion

The 40 percent increase in the expenditures for research will necessitate great effort in raising the funds to support the program proposed by our Committee on Research. This fund raising must be done quickly and we will need all of the help we can get from every member of the Society. The contributions from industry will have to be doubled if we are to reach our goal this year.

We have had recent meetings with our Committee on Research, our Ways and Means Committee, our Finance Committee and the members of our staff. We have been very pleased to see the evidence of so much enthusiasm, optimism, and ambition to see our objectives attained and the complete cooperation that exists between our research staff in Cleveland and our headquarters in New York.

Membership Roll

One problem which plagues us annually is our membership roll. At one time this was included in **THE GUIDE,** but when additional space was needed for technical material the membership roll was printed separately and a copy sent to each member.

A survey indicated that relatively few of our members used it and the cost of reproducing it at that time was of the order of $9000 per issue (for 8200 members). It appeared we were spending money that could be spent to better advantage in other ways.

Some of our members, however, need the membership roll very badly and, therefore, we cannot say we will eliminate it.

Furthermore, it must be reproduced frequently as it becomes obsolete due to resignations, addition of new members, and changes of address of existing members. In a year approximately 35 percent of the membership roll will be changed due to one or more of these reasons.

What we should do with our membership roll has been the subject of much debate and consideration by Council. Various schemes have been proposed and studies made of how the problem is handled by other engineering societies.

Last year it was decided to print 3000 copies at a cost of $5000 and sell them to our members for $1.00 each. Fewer copies would have cost us very little less. Only 730 copies were sold on this basis. This year we did not print a membership roll, but we must do so in the very near future as the present roll is of little use due to so many changes.

It has been proposed that we print as few copies as economically possible and make a nominal charge of $2.00 each to our members. For those who need these rolls, the charge is incidental. The availability of the membership roll and the price will be shown on the member's dues bill and any member wishing a copy can order it and pay for it with his dues. The membership roll will be sent to him when published.

Annual Meeting

The plans for the Annual Meeting in Philadelphia next January 24-27 are moving along very nicely and there is every evidence that it will be one of the finest meetings and expositions we have ever had. **If you have not already made your reservations, we urge that you do so immediately.**

You are urged to read the message on the next page about the latest developments on the Proposed Society name change.

Cordially,

L. N. Hunter

PRESIDENT

LATEST DEVELOPMENTS ON PROPOSED NAME CHANGE

By L. N. Hunter, President

The latest developments on the proposed name change for our Society are as follows:

ASHVE is incorporated under the laws of the State of New York and following the action taken by Council at our Semi-Annual Meeting in June, we applied to the Secretary of State of the State of New York to reserve the Air-Conditioning name for us in anticipation of a possible change. Such reservations are honored for forty days so at the end of each forty-day period we had to request that the time be extended. Following the receipt of our last request the Secretary of State advised that a further extension beyond the November expiration date would not be permitted.

Our attorney therefore advised us that if we are to avoid jeopardizing our right to the use of this name, that we act on the matter at a Special Meeting instead of waiting until the Annual Meeting of the Society in Philadelphia next January as originally contemplated.

Since our membership was informed of Council's action of last June many comments have been received regarding the change. As would be expected opinions differ. It is apparent, however, that there is much sentiment in favor of retaining the word "Heating" in our name along with "Air-Conditioning."

In view of these developments Council at its October 8th meeting decided to recommend the following action:

(*a*) That the name of the Society be changed to AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, INC.

(*b*) That a Special Meeting of the Society be held on or about November 22 to take action on this change.

The proposed name, if adopted, should satisfy those who feel so strongly that we must identify ourselves in the mind of the public, more closely with air conditioning, as it is understood by the public. The terms "Heating" and "Ventilating" themselves do not completely accomplish this.

On the other hand the proposed name is not substantially different than our present name and we should not lose the value of the great prestige and good will that has been created in our own and allied professions and industry by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. The popular abbreviation of A.S.H.V.E. would become A.S.H.A.E.

Regardless of when the meeting is held, all Society members who have the right to vote, and this is limited to Members and Associate Members, must be given the opportunity to vote either in person or by proxy. Holding a Special Meeting therefore, involves no unusual expense or difficulty on the part of the Society nor **does it deny our members of any of their rights and privileges,** since they can be present by proxy.

In order that action may be taken, we must have a vote favoring the change from a majority of all members entitled to vote. This means that over 3000 favorable proxies will be required and to get these in the short time available before November 22 will be a tremendous job. We most urgently request therefore, that all Chapter Officers cooperate by seeing that the matter is discussed at their chapter meetings and that their members forward their proxies immediately.

Council found itself facing hazards whether the meeting is held in November or January. If delayed until January we might find that we could not obtain the right to use "Air-Conditioning" in our name, if some other technical organization had acquired it. The hazard in holding a special meeting in November is however, that we may not be able to accumulate sufficient proxies to act in this short space of time. Council wishes to assure the membership however, that the Special Meeting should not be construed as a means to "railroad" this change or to curb debate and discussion. Before the voting takes place each Chapter will have had an opportunity for a full discussion at one or more meetings so that an informed membership can make its choice.

Banquet Speaker Eisenhower Highlights ASHVE 61st Annual Meeting

President of Pennsylvania State University Known for Service in Government, Education

An outstanding highlight of the 61st Annual Meeting of the Society will be the address delivered by Dr. Milton S. Eisenhower, president, The Pennsylvania State University, at the annual banquet on Wednesday evening, January 26 in the ballroom of the Bellevue-Stratford Hotel. Though related to the president of the United States, Dr. Eisenhower is far from just "Ike's brother". He has an enviable record of his own, covering over 25 years of government service dating back to 1924, when he was U. S. vice consul in Edinburgh, Scotland. From 1926 to 1942 he served in the Department of Agriculture as assistant to the secretary, director of information and co-ordinator of the Land Use Program. Dr. Eisenhower has served by presidential appointment on at least six special missions, including associate director, Office of War Information, 1942-1943, chairman of the United States National Commission for UNESCO, 1946-1948, and special ambassador and personal representative of the President of the United States on Latin American Affairs, 1953.

The ASHVE banquet speaker is equally renowned for his many years of service in the field of higher education. President of Kansas State College from 1943 to 1950, he became president of The Pennsylvania State College in 1950, now known as The Pennsylvania State University. Since 1946 he has served as chairman or as a member of a number of national programs working for better education for everyone. Among the citations and commendations Dr. Eisenhower has received for his tireless efforts on the behalf of others are the AMVETS of Pennsylvania 1952 Americanism Award, the Distinguished Service Award of the Pennsylvania Department of the American Legion for 1953, the Distinguished Service Award for 1953 of the American Farm Bureau Federation, and the 1954 Junior Achievement Award.

Dr. Milton S. Eisenhower

ASHVE members attending the 61st Annual Meeting will find that the Wednesday night banquet and the major address by Dr. Milton Eisenhower will provide a tremendous climax to a most successful meeting.

Final Arrangements

As January 24 and the opening of the annual meeting draws closer, members of the Philadelphia Committee on Arrangements are working diligently to provide the membership with good facilities for a successful meeting, an interesting program for the ladies, an entertaining Monday evening Buffet Supper and Dance as well as the grand finale of the Wednesday evening banquet.

Ample space has been secured at the Bellevue-Stratford for all the business, technical and social meetings and this, of course, will be the headquarters hotel for meeting.

Successful Exposition

The 12th International Heating & Ventilating Exposition, sponsored by the Society, will open at the Philadelphia Commercial Museum at 2:00 p.m., Monday, January 24 and run simultaneously with the Annual Meeting at the Bellevue-Stratford. A number of exhibitors have taken more space than ever before. In this largest show of its type ever held, more than 400 exhibitors have already reserved space to display a variety of units for wet heat, warm air heating, air moving equipment and control equipment. Also to be displayed are industrial boilers, ducts, registers, diffusers, convectors and radiators. As the Exposition will be open until ten o'clock every evening, except Friday when it will close at 6:00 p.m., there will be ample time for all members to see this display of the latest equipment without missing any of the business or technical sessions of the Society.

Ladies' Program

The Ladies' Entertainment and the Transportation Committees report that they have planned activities for each day, Monday through Thursday. Buses will be available on Monday for tours of the historic sites of Philadelphia, Fairmount Park and other points of interest. Tuesday the ladies will have an opportunity to visit Longwood Gardens, nationally known as an outstanding showplace of America. Located in Chester County, approximately 30 miles from Philadelphia, Longwood dates back to the days of William Penn. Buses will be available for this trip, and a luncheon

(Continued on p. 161)

PROGRAM — 61st ANNUAL MEETING

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

January 24-27, 1955

Bellevue-Stratford Hotel, Philadelphia, Pa.

Sunday — January 23

10:00 a.m. REGISTRATION — Burgundy Room — Lobby Floor
10:00 a.m. Council Meeting
4:00 p.m. Welcome Tea — (Burgundy Room)

Monday — January 24

9:00 a.m. REGISTRATION — Burgundy Room — Lobby Floor
9:30 a.m. FIRST TECHNICAL SESSION — Clover Room
  Call to Order — By Pres. L. N. Hunter
  Reports of Officers and Council
  Amendments to By-Laws
  E. F. Snyder, Jr., Chairman
  Ventilation Requirements for Removal of Tobacco Smoke, by C. P. Yaglou
  A Rapid General Purpose Centrifuge Sedimentation Method for Measurement of Particle Size Distribution, by K. T. Whitby
  Evaluation of Panel-Type Air Cleaners by Means of Atmospheric Dust, by H. A. Endres, W. T. Van Orman and R. P. Carter, Jr.
12:15 p.m. Welcome Luncheon — Ballroom — Bellevue-Stratford Hotel
2:00 p.m. Ladies bus trip; Historic Philadelphia or Art Museum
2:00 p.m. EXPOSITION — Opening of 12th International Heating and Air Conditioning Exposition — Commercial Museum
  Exhibit will close daily at 10:00 p.m. Monday through Thursday; will close Friday at 6:00 p.m. ASHVE Booth No. 68
4:00 p.m. Chapters Conference Committee Meeting
6:00 p.m. Delaware Valley, U.S.A. Frolic; Buffet Supper, Show, Dancing (The Benjamin Franklin Ballroom)

Tuesday — January 25

9:00 a.m. REGISTRATION — Burgundy Room — Lobby Floor
9:30 a.m. SECOND TECHNICAL SESSION — Ballroom
  Call to Order by Vice Pres. John E. Haines
  Report of Committee on Research — R. S. Dill, Chairman
  R. S. Dill, Chairman
  Preliminary Studies of Heat Removals by Cooled Ceiling Panel, by L. F. Schutrum and John Vouris
  Measurement of Angular Emissivity, by A. Umur, G. V. Parmelee and L. F. Schutrum
  Circuit Analysis Applied to Load Estimating, Phase II, by H. B. Nottage and G. V. Parmelee
  Report of Tellers of Election
11:00 a.m. Ladies Luncheon and Bus Trip to Longwood Gardens
12:00 noon EXPOSITION — 12th International Heating and Air Conditioning Exposition — Commercial Museum
2:00 p.m. Chapters Conference Committee Meeting

Wednesday — January 26

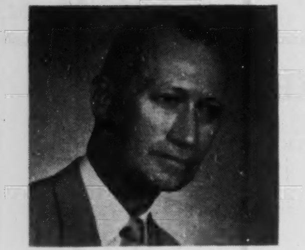
9:00 a.m. REGISTRATION — Burgundy Room — Lobby Floor
9:30 a.m. THIRD TECHNICAL SESSION — Ballroom
  Call to Order by Second Vice Pres. John W. James
  Prof. E. R. Queer, Chairman
  Gas is an Important Factor in the Thermal Conductivity of Most Insulating Materials, Part II, by R. M. Lander
  A New Method for Selection of Outside Design Temperature, by M. L. Ghai and R. Sundaram
  Study of Liquid-to-Liquid Heat Transfer in Hot Water Heaters, by F. W. Hutchinson, L. J. La Tart and N. W. Smith
  Cloudless Day Radiation, by R. C. Jordan and J. L. Threlkeld
12:00 noon EXPOSITION — 12th International Heating and Air Conditioning Exposition — Commercial Museum
12:30 p.m. Ladies Luncheon and Fashion Show (Warwick Hotel — Ballroom)
2:00 p.m. Nominating Committee Meeting
7:00 p.m. Banquet (Bellevue-Stratford — Ballroom)
  Speaker: Dr. Milton Eisenhower, President, Pennsylvania State University
  Installation of Officers
  Presentation of Past President's Emblem to L. N. Hunter

Thursday — January 27

9:00 a.m. REGISTRATION — Burgundy Room — Lobby Floor
9:30 a.m. FOURTH TECHNICAL SESSION — Ballroom
  Call to Order — L. N. Hunter, President
  Prof. Linn Helander, Chairman
  Paths of Horizontally Heated and Chilled Air Jets, by Alfred Koestel
  Air Conditioning of Multi-Room Buildings, by R. W. Waterfill
  Effects of Weather Conditions on Cooling Unit Operation in a Residence, by H. T. Gilkey and S. Konzo
  Report of Committee on Resolutions
  Unfinished Business
  New Business
  Adjournment
10:00 a.m. Ladies Bus Trip to Atlantic City; Luncheon (Haddon-Hall — Wedgewood Room) Boardwalk Sightseeing
12:00 noon EXPOSITION — 12th International Heating and Air Conditioning Exposition — Commercial Museum
1:00 p.m. Organization Meeting 1955 Council

Friday — January 28

12:00 noon EXPOSITION — 12th International Heating and Air Conditioning Exposition (Commercial Museum — Closes at 6:00 p.m.)

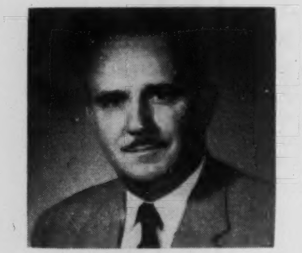


John Everetts, Jr.
Vice Chairman

John McElgin
General Chairman

Merrill F. Blankin
Honorary Chairman

Mrs. Merrill F. Blankin



Earle K. Wagner

Edwin H. Dafter

Philadelphia, Pa.

Committee on Arrangements

January 24-27, 1955

John McElgin
General Chairman

Merrill F. Blankin
Honorary Chairman

John Everetts, Jr.
Vice Chairman

Banquet — H. B. Prewitt, Chairman; E. I. Curley, H. R. James, F. R. Kelble, C. W. Procter, Jr., R. J. Sigel, R. H. Smiles, J. W. Sutch, G. E. Tuckerman, D. A. Wicks, E. I. Wildman.

Entertainment — E. K. Wagner, Chairman; R. H. Ackermann, F. H. Buzzard, P. A. Cavanagh, H. H. Erickson, H. J. Faltenbacher, J. H. Hucker, E. C. Lambert, C. J. Lubking, R. S. Mizener, F. F. Pfeiffer, Edward Semel, C. D. Shields, B. S. Urmstrom, K. W. Will.

Exposition — C. F. Dietz, Chairman; J. B. Banks, Warren Brewer, H. W. Doerrfuss, A. G. Dome, R. M. Gillett, J. P. Hartman, C. J. Kern, H. K. King, A. E. Kriebel, H. T. Makin, Jr., H. H. Mohrfeld, A. G. Mutimer, C. A. Rhea, R. M. Sharp, W. J. Sliney, G. F. Smith, W. D. Strause, H. N. Teuber.

Finance — P. H. Yeomans, Chairman; A. C. Caldwell, C. J. Forve, J. E. Hutchison, Leo Sudhaus.

Ladies — E. H. Dafter, Chairman; Mrs. M. F. Blankin, Co-Chairman; G. F. Bertrand, Isadore Director, E. L. Sederholm, Jr., M. J. Wind. Assisted by: Mmes. R. S. Arnold, G. F. Bertrand, F. H. Buzzard, L. M. Church, E. H. Dafter, C. F. Dietz, John Everetts, Jr., H. B. Hedges, G. E. Klapper, C. S. Leopold, Ludwig Mack, J. W. McElgin, H. B. Prewitt, A. M. Robertson, W. S. Scott, E. K. Wagner, P. H. Yeomans.

Publicity — Ludwig Mack, Chairman; G. P. Alexander, T. J. Atkins, Alan Dombro, Morris Sheffler, W. S. Scott.

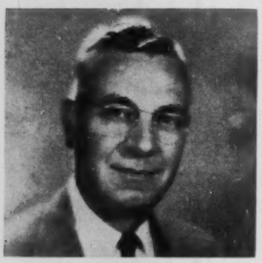
Reception — J. O. Kirkbride, Chairman; R. S. Arnold, R. J. Augusterfer, Lucien Buck, E. G. Carrier, W. P. Culbert, C. B. Eastman, Edwin Elliott, H. B. Hedges, J. H. Hucker, R. F. Hunger, H. N. Jacobs, M. G. Kershaw, A. H. Koch, C. S. Leopold, N. S. MacFarlan, W. W. Malloy, H. M. Parent, Karl Rugart, R. P. Schoenijahn, Pierce Timmis.

Sessions — A. M. Robertson, Chairman; R. W. Cromie, J. J. Hucker, M. A. Sheffler.

Transportation — G. W. Powell, Jr., Chairman; R. L. Bitzer, J. M. Johnston, H. H. Mather, R. A. Metz, B. P. Morabito, H. V. Mount, Jr., M. J. Murray, G. W. Powell, R. V. Smith, R. B. Twining.

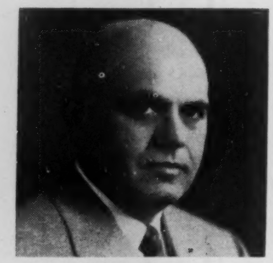
Ludwig Mack

George W. Powell, Jr.



Lloyd M. Church

Paul H. Yeomans



H. B. Prewitt

C. Fred Dietz

Archie M. Robertson

J. Owen Kirkbride

(*Continued from p.* 158)

is scheduled at an attractive restaurant en route. A fashion show and luncheon at the Hotel Warwick is planned for Wednesday. Thursday, there will be a bus ride to Atlantic City and lunch at Haddon Hall. Before the return to Philadelphia, time will be available to walk the boardwalk.

The Philadelphia Committee on Arrangements reports that in addition to a well-rounded program of technical sessions there will be a Welcome Tea Sunday afternoon at four, and Welcome Luncheon Monday.

NOTICE OF NOVEMBER 22, 1954 SPECIAL MEETING of The American Society of Heating and Ventilating Engineers

PLEASE TAKE NOTICE that a Special Meeting of the Society will be held at the Hotel Statler, New York, N. Y., on November 22, 1954, at 2:00 P.M. The purpose for which such meeting is called is:

To act upon a proposal to change the name of the Society from The American Society of Heating and Ventilating Engineers to American Society of Heating and Air-Conditioning Engineers, Inc.

No other business will be transacted at said meeting.

Dated, New York, N. Y., October 15, 1954.

By Order of the Council
L. N. HUNTER, *President*
A. V. HUTCHINSON,
Executive Secretary

CORRECTION

Due to printer's error, the following corrections are required in the paper, Selection of Outside Design Temperature for Heat Load Estimation, by M. L. Ghai and R. Sundaram, published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1954, p. 137.

Appendix A, p. 141:

1. In Equation A-2, change λ to λ_1.
2. In the first two equations in center column, also change λ to λ_1.

ASHVE COUNCIL MEETING HELD IN INDIANAPOLIS

Twenty officers and members of the Council, Executive, Finance, and Long-Range Planning Committees met with Pres. L. N. Hunter in Indianapolis on October 7-8 to conduct the business of the Society.

Attending the ASHVE meetings, in addition to President Hunter, were First Vice Pres. J. E. Haines, Minneapolis; Second Vice Pres. John W. James, Chicago; Treasurer E. R. Queer, State College, Pa.; and Executive Secretary A. V. Hutchinson.

The meetings were held in the Columbia Club, and the officers and committee members were the guests of the Indiana Chapter. On Friday evening after the Council adjourned, the ASHVE officers and commiteemen were guests at a dinner meeting of the local chapter, at which time President Hunter addressed the members, telling them about current projects and ambitions of the Society. He also introduced E. R. Kaiser, ASHVE director of research.

Council members meeting with President Hunter and Vice President Haines were A. J. Hess, Los Angeles; B. W. Farnes, Portland, Ore.; B. H. Spurlock, Jr., Boulder, Colo.; P. B. Gordon, New York; Reg. F. Taylor, Houston; L. T. Mart, Kansas City, Mo.; C. H. Pesterfield, East Lansing, Mich.; J. H. Fox, Toronto, Ont.; R. T. Kern, Leominster, Mass., D. M. Mills, Houston; A. W. Edwards, Cincinnati; I. W. Cotton, Indianapolis; and M. K. Fahnestock, Urbana, Ill.

Also present were, W. J. Collins, Jr., Oklahoma City, chairman, Chapters Conference Committee; G. D. Winans, Detroit, chairman Charter and By-Laws Committee; and R. S. Dill, Washington, D.C., chairman of Committee on Research.

On Thursday John W. James, chairman of the Finance Committee, held a meeting, and the members present were A. J. Hess, L. T. Mart, E. R. Queer, and P. B. Gordon, a member of the Ways and Means Committee. A meeting of the Executive Committee under the chairmanship of J. E. Haines, and a meeting of the Long-Range Planning Committee under the same chairman, also were held on Thursday. Present at the Executive Committee meeting were Mr. James and Professor Queer. The Long-Range Planning Committee meeting was attended by Messrs. Gordon, Hess and James.

Panorama of Progress at Columbia University

(Seated l. to r.) Dr. Ernst Schmidt, Munich; W. L. Fleisher, past president of ASHVE; G. S. Jones, Jr., managing director, *Air Conditioning and Refrigeration Institute;* Dr. Lyman Bryson, professor emeritus, and Dr. J. R. Dunning, dean, School of Engineering, both of Columbia University; *(standing l. to r.)* J. E. Haines, 1st vice president of ASHVE; A. J. Hess, member of ASHVE Council and president of *ASRE;* ASHVE Pres. L. N. Hunter; Dr. S. C. Prescott, dean emeritus of science at MIT; G. Ruppel, Dr. of Engrg., Karlsruhe; H. C. Diehl, director of *The Refrigeration Research Foundation;* Prof. Carl F. Kayan, executive officer, Department of Mechanical Engineering, Columbia University

JOURNAL SECTION

Summary of

Another Chapter Added As Toledo Makes It 58

The formation of the 58th Chapter of the Society, with approximately 100 charter members, took place October 4, in Toledo, Ohio. Pres. L. N. Hunter welcomed the Chapter into the Society and presented the members with their charter. A. V. Hutchinson, executive secretary, presented the Chapter president, Frank C. Richardson, with his gavel and a set of record books. The major address of the evening was delivered by S. R. Lewis, ASHVE past president and life member from Chicago. Toledo City Manager John J. McCarthy and Dr. A. S. Knowles, University of Toledo president, spoke briefly congratulating the local engineers on the formation of their chapter in ASHVE. The invocation was offered by Rev. C. A. Hackenberg, pastor of Holy Trinity Lutheran Church.

In addition to Mr. Richardson, the following members were installed by President Hunter as officers of the local chapter: G. H. Frost, vice president; J. F. Guest, secretary; R. O. Bennington, Jr., treasurer; F. A. Edgington, L. B. LaFrance and D. W. MacDermid as members of the board of governors.

The evening meeting in the Toledo Club was preceded by a six o'clock reception, social hour and dinner. C. F. Hoffman was chairman of the committee which handled the arrangements for the charter meeting.

• *CENTRAL OHIO*: Dinner was served at the Fort Hayes Hotel, with W. R. Kinney as "coffee speaker" previous to the September meeting. By unanimous approval, Pres. J. A. Guy and Vice Pres. R. A. Wilson were named as delegate and alternate to the 61st Annual Meeting at Philadelphia in January. A motion was unanimously carried that the Chapter President be custodian of the Chapter Charter. A Past President's pin was presented to N. T. Hess.

A Trouble Panel, consisting of J. D. Slemmons, Ray Little, John Drake and T. R. Walker, gave an interesting discussion. Attendance 41. Attendance ratio 0.35.

• *CONNECTICUT*: Following a conducted tour through the submarine base at Groton and dinner at Skipper's Dock in Noank, Pres. C. L. L'Hommedieu welcomed the members and guests to the September meeting. Comdr. G. M. Inscoe, Lt. J. B. Jones and Seaman William Woodruff conducted the tour which was arranged by C. G. Chapin.

R. B. Cahoon, membership committee chairman, announced the names of the new members; J. J. Morro explained the action taken by the legislative committee to assist the city of New Britain with its Refrigeration Code, and G. F. Nieske expressed appreciation upon receipt of his Past President's pin. Discussion on the proposed change of the Society's name was tabled until further information could be obtained. Fritz Honerkamp, program committee chairman, thanked W. A. Johnson for his part in arranging the meeting. Attendance 51. Attendance ratio 0.19.

• *EMPIRE STATE CAPITAL*: General discussion on the proposed change of the Society's name resulted in agreement to notify the Executive Secretary of the Chapter's opposition to the change to American Society of Air Conditioning Engineers. Also at the September meeting, Empire State Capital members expressed accord with the chapter redistricting plan outlined by the Chapter Relations Committee. Pres. E. C. Doyle asked that all new applications be presented to R. F. Peck, membership chairman, Secretary H. F. Kruger or to himself, and then channelled through the board of governors.

F. R. Foote introduced E. A. Windham, Kathabar Division, Surface Combustion Co., New York, N. Y., whose talk on Kathabar, Its Application and Control was followed by a bombardment of questions. Attendance 26. Attendance ratio 0.27.

• *KANSAS CITY*: Facilities of the Mid-Continent International Airport now under construction for Kansas City were described by R. M. White, director of aviation for Kansas City, in a brief speech at the September meeting. E. S. McCarthy, manager of aircraft specifications, Trans World Airlines, introduced by A. S. Hurt, Jr., explained the systems of air conditioning on modern passenger airliners, including heating, ventilating, mechanical cooling and pressurizing.

As alternate delegate, Mr. Hurt reported on the Chapters Conference Committee meeting at Swampscott in June. At Pres. F. K. Ladewig's request, each committee chairman reported on the activities, future plans and membership of his committee. Attendance 90. Attendance ratio 0.32.

• *MISSISSIPPI*: Introduced by R. E. Vernon at the September meeting, W. B. Firman, sales manager, and W. P. Williams, district manager, Orr and Sembower, Inc., Reading, Pa., gave an interesting program on Automatic Packaged Boilers.

In preparation for the November elections it was decided that the board of governors would meet previous to the next general meeting to appoint a nominating committee. Treas. T. E. Stepan read his financial report. Attendance 24.

• *NEW MEXICO*: Together with the New Mexico Society of Professional Engineers, New Mexico Chapter members enjoyed a talk by H. K.

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*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Chapter Meetings*

Ryan, Denver, Colo. — Is the New Mexico Registration Law in Jeopardy? Following a lively discussion period, the ASHVE members retired for a short September business meeting, presided over by H. F. Munn.

Secy. J. K. James was instructed to write to Society Headquarters expressing the feeling of the Chapter as 60 percent against and 40 percent for the change in the Society's name. C. R. Wherritt, chairman of the program committee, discussed the meeting places and programs for the coming year, and the treasurer's report was given by R. W. Haines.

• *NORTH TEXAS*: The Selection of Induction Motors for Heating, Ventilating and Air Conditioning Equipment was the subject of a talk by George Nafe, Century Electric Co., who was introduced to the members at the September meeting by V. G. Cox.

Pres. M. W. Brown read an invitation from the Southwest Texas Chapter to attend their October meeting. On the agenda for discussion were the Polio Fund — the money collected will be distributed among those who have been afflicted; the Giesecke Fund — voluntary donations will be given to start this fund; and the Christmas Party — to be held on December 20. Attendance 79.

• *NORTHEASTERN OKLAHOMA*: V. H. Lyon, district manager, Eutectic Welding Alloys Corp., discussed low temperature welding at the September meeting. The speaker was introduced by J. R. Shipman.

C. H. Dollmeyer noted the reorganization changes proposed at the Chapters Conference Committee meeting held in Swampscott. Secy. J. T. McKinney showed the name badges to be used at future meetings.

• *OREGON*: Pres. E. E. Kelly presided at the September meeting. An interesting talk on the test chamber at Inyokern, Calif., was given by L. R. Charde, York Corp., Los Angeles. Mr. Charde discussed the original design, installation and acceptance of the chamber. Some of the feats performed there have been the transfer of temperature from 125 F to −80 F in two minutes, and the transfer of conditions at 50,000 ft to sea level in 17 seconds with constant humidity control.

Councilman B. W. Farnes reported on the recent extension of the Society staff. He also urged all members to read Pres. L. N. Hunter's article in the August Journal Section.

• *ST. LOUIS*: Water Cooling Equipment for Air Conditioning and Refrigeration was the subject of an excellent talk presented by H. E. Degler, technical director, Marley Co.

The water shortage problem is becoming increasingly worse, according to Mr. Marley, and as proof he cited some statistics on current usage in Kansas City where water conserving equipment is required on all units of 5 tons or larger. During the peak demand period the air conditioning load accounts for 15 percent of the water consumption, but only 5 percent of the annual consumption.

Mr. Degler discussed the design and operating characteristics of towers and stated that increasing the wood fill in a tower increased the capacity. Natural draft towers are designed for a wind velocity of 3 mph, but even with no wind there is an aspirating effect due to the air warming. He also covered details of the cross flow towers, scale accumulation and prevention, and economics of their operation. He closed with a summary of difficulties usually encountered in towers, i.e., faulty motors, insufficient lubrication, overpumping, noise and incorrect water treatment.

The September meeting was called to order by Pres. G. H. Bemarkt. H. C. Sharp reported on the Semi-Annual meeting and advised the members of the proposed change in Society name and the proposed new regional plan for Society Chapter operations.

• *SOUTHERN CALIFORNIA*: Norman Sharpe, head of the Air Conditioning and Refrigeration Dept., California State Polytechnic College, San Luis Obispo, gave a stimulating talk on the reasons for overestimation of the cooling load.

Presented to the membership and guests at the September meeting by J. R. Hall, program chairman, Mr. Sharpe first defined "heat gain" as the scene of two types of energy — convected and radiant. He stated that the cooling load imposed on an air conditioning system is entirely convected; radiant energy can only indirectly be part of the cooling load. To obtain an accurate cooling load estimate, we must eliminate the radiant energy except for the portion which is converted to convected energy for the time at which the cooling load is calculated.

Mr. Sharpe indicated that on this basis the convected cooling load at the design time is considerably below the heat gain commonly used under similar circumstances and that which would be obtained from THE GUIDE with the listed factors. It was finally suggested that complete separation of radiant and convected energies should be effected in THE GUIDE tabular data.

Business of the meeting included the introduction of committee members and chairmen by Pres. C. D. Walz, who stressed the prime objective of the new chapter affairs committee — the coordination and improvement of local operations. He also urged attendance at the January Annual Meeting in Philadelphia. The proposed change of name for ASHVE was discussed briefly and then held in abeyance so that all members would give the matter serious consideration. Attendance 92.

JOURNAL SECTION

Candidates for

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society, or mailed to all members. When the replies are received from references the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month there have been 84 applications for membership, including 4 reinstatements; in addition 15 advancements have been received. The names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by November 30, 1954, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

Note: †Reinstatement. *Non-member. △Advancement.

Arkansas

△Swindler, C. P., Vice Pres., General Air Conditioning Corp., Little Rock. References: Edward Cromwell*, Frank Ginocchio*, C. H. Miller, J. A. Wellons.

California

△Aguilar, M. R., Cons. Engr., Buonaccorsi, Murray & Lewis, San Francisco. References: A. L. Buonaccorsi, Charles Lambert, J. E. Murray, J. B. Smith.

Cumming, E. P., Dist. Sales Repr., Airfloor Co. of Calif., Inc., San Francisco. References: H. F. d'Autremont, G. L. Gendler, L. J. Leemhuis*, M. G. Lowe*.

Fink, Harry, Pres., A & S Air Conditioning, Los Angeles. References: M. C. Griener, A. J. Hess, R. A. Lowe, Stanley Polland.

Hodnett, L. A., Partner, C. B. Hodnett & Son, Sacramento. References: J. E. Day, R. M. Graham, A. A. Hershfield, J. E. Marshall.

△Hollander, G. M., Sr. Mech. Engr., Div. of Archt., State of Calif., Los Angeles. References: W. J. Biggar, J. L. McCullough, F. M. Neal, R. R. Roche*.

△Lander, W. B., Asst. Chief Mech. Engr., U. S. Army Corps of Engrs., Sacramento. References: S. W. Doolittle, J. E. Marshall, E. C. McKinsey, L. A. O'Meara.

Ludovise, O. C., Mech. Designer, Welton Becket & Assocs., Los Angeles. References: B. M. Lemos, W. M. Norton, L. B. Rayl, R. C. Snow.

△Sanford, K. C., Mech. Engr., L. A. O'Meara, Cons. Engr., Sacramento. References: S. W. Doolittle, J. E. Marshall, L. A. O'Meara, Arthur Roth.

△Shafer, M. D., Owner, Marvin D. Shafer Co., Los Angeles. References: J. H. Bell, W. J. Biggar, A. J. Hess, Stanley Polland.

Georgia

Austin, J. W., Jr., Cons. Engr., Atlanta. References: C. B. Cole, E. W. Klein, Jr., W. J. McKinney, M. W. Wise.

Illinois

†Gray, S. A., Sales Mgr., Minneapolis-Honeywell Regulator Co., Chicago. References: B. C. Benson, John Clark*, J. F. Cummiskey, J. C. Scott.

△Lindvall, D. E., Dir. of Heating, Central Illinois Electric and Gas Co., Rockford. References: C. J. Braatz, W. W. Kennedy, V. M. Lather, P. L. Taxon.

Thompson, A. R., Jr., Repr., The Marley Co., Chicago. References: E. H. Gage, E. T. Gessell, Herbert Kreisman, L. T. Mart.

Indiana

Bennett, E. M., Jr., Sales Mgr., Htg. Div., Meier Electric & Machine Co., Indianapolis. References: Thomas Ayton*, R. F. Forbes, Harold Kirk*, Albert Paley*.

Iowa

Merfen, K. J., Mgr. Htg. Dept., Plumbing Supply Co., Des Moines. References: J. R. Bain, G. E. Mellerup, Walter Peterson, W. B. Schuler.

Townsend, M. B., Pres., Gibson-Townsend Co., Des Moines. References: L. E. Gnade, Walter Peterson, F. L. Pulley, R. H. Schnell.

Kansas

Ray, R. R., Owner, Shawnee Mission Plbg., Htg. & Air Cond., Merriam. References: M. Barnes*, J. H. Cochrane, E. F. Hocker, Arthur Suiter*.

Kentucky

Arenz, E. C., Appl. Engr., American Air Filter Co., Inc., Louisville. References: J. M. Kane, W. J. Killian, J. W. May, G. S. Stock.

Harms, J. D., Research Engr., American Air Filter, Louisville. References: Fred Brown*, A. T. Ippen*, J. W. May, Arthur Nutting.

Kayse, J. R., Supvsg. Engr., American Air Filter Co., Inc., Louisville. References: John Hellstrom, J. M. Kane, J. W. May, R. W. Nelson.

Lilly, L. W., Design Engr., American Radiator and Standard Sanitary Corp., Louisville. References: R. B. Duggan, F. E. Hanson, L. L. Smith, J. B. Uhl.

Logsdon, R. F., Asst. Dir. of Research, American Air Filter Co., Inc., Louisville. References: F. T. Carroll, Jr., J. W. May, H. J. Noles, Arthur Nutting.

Rademaker, R. W., Br. Mgr., Barber Colman Co., Louisville. References: F. T. Carroll, Jr., J. W. May, L. G. Plaehn, D. J. Rank.

†Sutter, J. O., Br. Commercial Mgr., Minneapolis-Honeywell Regulator Co., Louisville. References: E. T. Clucas, J. F. Cummiskey, J. C. Hennings*, B. C. Simons.

Vinsel, K. P., Jr., Field Engr., Griffin & Co., Louisville. References: O. J. Hill, J. M. Kane, S. E. Shelby*, J. D. Stewart, Jr.*

Westlin, K. L., Research Engr., American Air Filter Company, Inc., Louisville. References: John Hellstrom, J. M. Kane, J. W. May, Arthur Nutting.

Wickham, A. L., Design Engr., American Radiator & Standard Sanitary Corp., Louisville. References: R. B. Duggan, F. E. Hanson, L. L. Smith, J. B. Uhl.

Willis, J. J., Market Mgr., American Air Filter Co., Louisville. References: Merl Baker, A. F. Hubbard, J. M. Kane, R. B. Knight.

Youker, R. D., Partner, David J. Rank Co., Louisville. References: W. J. Killian, R. W. Nelson, D. J. Rank, C. S. Stock.

Massachusetts

Burke, R. F., Jr., Engr., Tucker & Rice, Inc., Worcester. References: W. L. Bachman, W. G. Martin, Jr., J. M. Means, W. H. Shipp.

Michigan

Byrne, C. R., Vice Pres., W. J. Rewoldt Co., Detroit. References: R. L. Deppman, E. F. Glanz, D. J. King, H. E. Paetz.

Membership

Curtis, J. F., Sales Engr., The Coon De Visser Co., Detroit. References: E. F. Glanz, H. H. Hughson, J. N. Livermore, R. V. B. Martelli.

△Owen, Douglas, Charge of Mech. Engrg. Dept., Swanson Associates, Bloomfield Hills. References: Robert Brodie*, John Palms*, Lawrence Saltz*, John Sickling*.

Pyne, J. F., Asst. Sales Mgr., The American Brass Co., Detroit. References: E. F. Glanz, R. K. Milward, W. H. Old, G. S. Whittaker.

Richards, F. C., Repr., E. J. Anderson Co., Detroit. References: E. J. Anderson, E. F. Glanz, W. H. Old, W. J. Whelan.

Missouri

Beeson, R. S., Owner, Ralph S. Beeson, Mfrs. Repr., Kansas City. References: D. M. Allen, Gibson Hart, Henry Kleikamp, Henry Nottberg.

Finnegan, J. J., Estimator, Sodemann Heat & Power Co., St. Louis. References: C. A. Beckermann, E. E. Carlson, E. T. Clucas, C. R. Davis.

Jennings, R. D., Purchasing Agent & Estimator, Sodemann Heat & Power Co., St. Louis. References: E. E. Carlson, E. T. Clucas, C. R. Davis, B. L. Evans.

Kline, R. B., Repr., Owens-Corning Fiberglas Corp., Kansas City. References: J. C. Fasnacht, J. E. Kindred, P. A. Moreno, R. M. Perkins.

Medved, M. P., Partner, Gilbert F. Hellmer, Kansas City. References: C. C. Chappelow*, G. F. Hellmer, W. E. McConnell*, D. F. Shimon*.

O'Maley, G. T., Part Owner, Air Refrigeration Corp., Kansas City. References: F. V. Becklean*, J. R. DeRigne, B. C. Smith, G. H. Stoffer.

Paul, F. P., Secy. & Treas., Edwin P. Ambler, Inc., St. Louis. References: C. A. Durphy, D. S. Levinson, R. A. Schulte, H. C. Shaid.

Rieth, V. J., Engr., Sodemann Heat & Power Co., St. Louis. References: C. A. Beckermann, E. E. Carlson, E. T. Clucas, B. L. Evans.

Roberts, A. L., Jr., Sales Repr., The Trane Co., Kansas City. References: F. K. Ladewig, R. B. Luhnow, Jr., P. A. Moreno, R. W. Tobey.

Schnell, E. H., Estimator, Sodemann Heat & Power Co., St. Louis. References: E. T. Clucas, J. W. Cooper, C. R. Davis, B. L. Evans.

Wilkening, V. A., Engr., Sodemann Heat & Power Co., St. Louis. References: C. A. Beckermann, E. E. Carlson, C. R. Davis, W. J. Oonk.

Zimmermann, M. H., III, Engr., Natkin & Co., Kansas City. References: D. M. Allen, W. K. Dyer, C. D. Hawley, E. E. Ralston.

Nebraska

Lane, W. F., Vice Pres., D. E. McCulley Co., Omaha. References: T. E. Davis, W. B. Howard, Orville Pratt, E. N. Seiler.

Scott, R. J., Sales Engr., Sidles Conditioned Air Co., Omaha. References: G. W. Colburn, R. N. Gates, Robert Morgan*, L. J. Paulsen.

Scott, W. M., Pres.-Treas., Wray M. Scott Co., Inc., Omaha. References: B. G. Peterson, Orville Pratt, Verne Simmonds, Frank Williamson.

New Jersey

Bradley, C. B., Chief of Physics Sect., Johns-Manville Research Center, Manville. References: C. H. Flink, C. M. Humphreys, N. B. Hutcheon, E. R. Queer.

Flaherty, E. J., Engr., Worthington Corp., Harrison. References: Joseph Avignoni*, A. Clarke*, Arthur Posquariello*, Donald Rasmusson*.

New York

Esrum, Ove, Engr., Abbott, Merkt & Co., Inc., New York. References: R. J. Bush, Ernst Graber, C. E. Langgaard*, R. H. Tatlow*.

Lehman, R. W., Mfr's. Repr., The Trane Co., Buffalo. References: Joseph Davis, Roswell Farnham, D. J. Mahoney, C. W. Stone.

Morrison, Carl, Sales Engr., Worthington Corp., New York. References: Nathan Feder, D. H. McQuaig*, Daniel Spiegel, J. W. Wait.

Page, H. F., Designer, Abbott Merkt & Co., New York. References: R. J. Bush, A. L. Crichton, J. T. Falk, Ernst Graber.

†Schuler, W. R., Mech. Engr., Sargent-Webster-Crenshaw & Folley, New York. References: J. H. Hanchett, H. K. Ormsby, D. K. Sargent*, C. F. Woese.

Ohio

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Toronto, Ont., Can.

T. Clyde Clapperton, a member of the Toronto Chapter, died suddenly on September 17, 1954, at St. Catherines, Ont. Born in Toronto on June 19, 1905, Mr. Clapperton attended the Central Technical School there and the University of Toronto.

From 1924 to 1937, he was connected with Bennett & Wright, Ltd., starting as estimator for plumbing and heating, and ultimately serving as assistant general manager in charge of engineering. He became associated with Michael Stuart Co., Ltd., as vice president and general manager, and with S. M. Peterkin Co., Ltd., as vice president in 1937. He was in this latter connection at the time of his death. Mr. Clapperton worked with steam, hot water, warm air and radiant heating systems on various projects—central housing developments, industrial buildings, schools, television and radio stations. He became a member of ASHVE in 1944.

Surviving are his wife, Pauline, his daughter, Donna, and his son, Michael, who is now starting his engineering studies. The Officers and Council of the Society extend their sympathy to his family.

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ASHVE — OFFICERS OF CHAPTERS AND BRANCHES

(58 Chapters; 1 Special Branch; 8 Student Branches)

Date indicates year organized; an address and no city shown signifies same city as headquarters; numeral in parentheses indicates zone.

- **ARIZONA:** 1953. Hdqrs., Phoenix. Meets, First Monday. PRESIDENT, V. J. Carns, 3602 No. 15th Dr. SECRETARY, A. J. Nelesen, Jr., 6744 No. 14th Pl.
- **ARKANSAS:** 1952. Hdqrs., Little Rock, Ark. **Meets,** Third Tuesday. PRESIDENT, R. E. Blaylock, 509 E. Markham St. SECRETARY, J. L. Brown, 212 Terminal Warehouse Bldg.
- **ATLANTA:** 1937. Hdqrs., Atlanta, Ga. Meets, Second Monday. PRESIDENT, J. M. Lazenby, 8 11th St., N.E. SECRETARY, F. W. Bull, 1205 Spring St., N. W.
- **BALTIMORE:** 1949. Hdqrs., Baltimore, Md. Meets, Third Wednesday. PRESIDENT, E. H. Taze, 33 E. 21st St. (18). SECRETARY, R. F. Weisman, 4650 Reisterstown Rd., (15).
- **BRITISH COLUMBIA:** 1952. Hdqrs., Vancouver, B.C., Canada. Meets, Second Wednesday. PRESIDENT, S. C. Gale, 1628 W. 4th Ave. SECRETARY, D. A. English, 1606 W. 1st Ave. (9).
- **CENTRAL NEW YORK:** 1944. Hdqrs., Syracuse, N. Y. Meets, Fourth Wednesday. PRESIDENT, F. D. Putnam, 115 Pulsifer Dr., Auburn. SECRETARY, Merle Weninger, 230 Goodrich Ave. (5).
- **CENTRAL OHIO:** 1944. Hdqrs., Columbus, Ohio. Meets, Third Monday. PRESIDENT, J. A. Guy, 478 W. Fifth Ave. (1). SECRETARY, W. A. Schoonover, 2901 N. High St. (2).
- **CINCINNATI:** 1932. Hdqrs., Cincinnati, Ohio. **Meets, First Tuesday.** PRESIDENT, F. W. Wilson, 222-24 E. 14th St. SECRETARY, R. G. Anderson, 1758 Elmore St. (23).
- **CONNECTICUT:** 1940. Hdqrs., New Haven, Conn. Meets, Third Thursday. PRESIDENT, C. L. L'Hommedieu, 76 Blatchley Ave. SECRETARY, Walter Heywood, 14 Hartt Lane, Newington.
- **DELTA:** 1939. Hdqrs., New Orleans, La. Meets, Third Tuesday. PRESIDENT, C. V. Bankston, 2927 Jackson Ave. (25). SECRETARY, W. B. Martin, Jr., 2014 Rendon St. (15).
- **EMPIRE STATE CAPITAL:** 1951. Hdqrs., Albany, N. Y. Meets, Second Wednesday. PRESIDENT, E. C. Doyle, 315 Washington Ave. SECRETARY, H. F. Kruger, 501 Seventh Ave., Troy.
- **GOLDEN GATE:** 1937. Hdqrs., San Francisco, Calif. Meets, First Thursday. PRESIDENT, Eric Roberts, 417 Market St. SECRETARY, F. K. Crouch, 906 Cerrito St., Albany (6).
- **ILLINOIS:** 1906. Hdqrs., Chicago, Ill. Meets, Second Monday. PRESIDENT, George V. Zintel, 840 N. Michigan Ave. (11). SECRETARY, H. G. Gragg, 228 N. LaSalle St. (1).
- **INDIANA:** 1943. Hdqrs., Indianapolis, Ind. Meets, Fourth Tuesday. PRESIDENT, P. O. Patterson, 2701 Roosevelt Ave. SECRETARY, A. O. Roche, Jr., 3950 Broadway (5).
- **INLAND EMPIRE:** 1950. Hdqrs., Spokane, Wash. Meets, First Monday. PRESIDENT, H. A. Bickel, E. 7 Riverside Ave. SECRETARY, Max Tonn, S. 4021 Latawah St.
- **IOWA:** 1940. Hdqrs., Des Moines, Ia. Meets, Second Tuesday. PRESIDENT, W. E. Nanes, 220 Davidson Bldg. SECRETARY, D. E. Schroeder, 2717 Cambridge.
- **KANSAS:** 1951. Hdqrs., Wichita, Kan. Meets, Tuesday after First Monday. PRESIDENT, Charles Yoe, P.O. Box 2239. SECRETARY, T. L. Roberts, 2008 S. Parkwood Lane.
- **KANSAS CITY:** 1917. Hdqrs., Kansas City, Mo. Meets, First Monday. PRESIDENT, F. K. Ladewig, 3527 Broadway (11). SECRETARY, R. M. Spencer, 1510 Main St. (8).
- **MANITOBA:** 1935. Hdqrs., Winnipeg, Man., Canada. Meets, Fourth Thursday. PRESIDENT, G. T. Christie, Midland & Notre Dame. SECRETARY, A. J. McIntyre, 935 Garwood Ave.
- **MASSACHUSETTS:** 1912. Hdqrs., Boston, Mass. **Meets, Third Tuesday.** PRESIDENT, G. W. Sprague, 108 Cummington St. SECRETARY, W. G. Burbo, 137 Newbury St. (16).
- **MEMPHIS:** 1944. Hdqrs., Memphis, Tenn. **Meets, Third Monday. PRESIDENT, A. W. Shelby, 972 Union Ave. SECRETARY, A. T. Bevil, 1638 Union Ave. (4).**
- **MIAMI VALLEY:** 1950. Hdqrs., Dayton, Ohio. **Meets, First Wednesday. PRESIDENT, John Schweiger, 593 Acorn Drive, (9). SECRETARY, D. E. Tullis, 743 Kiser St. (4).**
- **MICHIGAN:** 1916. Hdqrs., Detroit, Mich. Meets, First Monday after 10th of month. PRESIDENT, E. F. Glanz, 1761 W. Forest Ave. (8). SECRETARY, J. H. Spitzley, 1200 Fort St., W. (26).
- **MINNESOTA:** 1918. Hdqrs., Minneapolis, Minn. Meets, First Monday. PRESIDENT, J. A. Craig, 814 South Ninth St. (4). SECRETARY, E. T. Erickson, 500 Baker Arcade (2).
- **MISSISSIPPI:** 1953. Hdqrs., Jackson, Miss. PRESIDENT, I. E. Rowe, 120 Georgia St. SECRETARY, M. E. Price, 144 S. Congress St.
- **MONTREAL:** 1936. Hdqrs., Montreal, Que., Canada. Meets, Third Monday. PRESIDENT, D. L. Lindsay, 4350 Sherbrooke St. (6). SECRETARY, S. R. Plamondon, 2267 Melrose Ave. (14).
- **NEBRASKA:** 1940. Hdqrs., Omaha, Neb. Meets, Second Tuesday. PRESIDENT, C. A. Goth, 3115 N. 49th Ave. SECRETARY, L. J. Paulsen, 1901 S. 39th St.
- **NEW MEXICO:** 1954. Hdqrs. Albuquerque, N.M. PRESIDENT, J. H. Van Alsburg, 1330 Cerro Gordo, Santa Fe. SECRETARY, J. K. James, 4462 Avenida del Sol.
- **NEW YORK:** 1911. Hdqrs., New York, N. Y. Meets, Third Monday. PRESIDENT, R. L. Stinard, 51 E. 42nd St. (17). SECRETARY, Carl H. Flink, 62 Worth St. (13).
- **NORTH JERSEY:** 1952. Hdqrs., Newark, N. J. Meets, Second Tuesday. PRESIDENT, H. M. Patrick, 20 Olcott Ave., Bernardsville. SECRETARY, W. C. Kruse, Jr., 183 N. 13th St. (7).
- **NORTH TEXAS:** 1938. Hdqrs., Dallas, Tex. Meets, Third Monday. PRESIDENT, M. W. Brown, 1213 Texas Bank Bldg. SECRETARY, H. G. Gregerson, 2921 Fairmount.
- **NORTHEASTERN OKLAHOMA:** 1948. Hdqrs., Tulsa, Okla. Meets, Second Tuesday. PRESIDENT, R. W. Winget, 2428 E. 11th St., Box 100. SECRETARY, J. T. McKinney, 1341 So. Boston.
- **NORTHERN OHIO:** 1916. Hdqrs., Cleveland, Ohio. Meets, Second Monday. PRESIDENT, D. E. Mannen, 9104 Woodland Ave. (3). SECRETARY, H. R. Canoyer, 1900 Superior Ave. (14).
- **NORTHERN PIEDMONT:** 1952. Hdqrs., Greensboro, N.C. Meets, Second or Third Friday. PRESIDENT, R. B. Crosland, Jr., 1001 S. Marshall St., Winston-Salem. SECRETARY, W. H. Cooper, 1001 S. Marshall St., Winston-Salem.
- **OKLAHOMA:** 1935. Hdqrs., Oklahoma City, Okla. Meets, Second Monday. PRESIDENT, G. E. Ervin, 2800 N. Oklahoma St. (5). SECRETARY, F. R. Denham, 320 Oklahoma Natural Bldg.
- **ONTARIO:** 1922. Hdqrs., Toronto, Ont., Canada. Meets, First Monday. PRESIDENT, M. C. Bailey, 1139 Bay St. SECRETARY, H. R. Roth, 57 Bloor St., W.
- **OREGON:** 1939. Hdqrs., Portland, Ore. Meets, Thursday after First Tuesday. PRESIDENT, E. E. Kelly, 4504 S.W. Corbett Ave. (1). SECRETARY, K. N. Flocke, 3027 N.E. 31st Ave. (12).
- **OTTAWA VALLEY:** 1952. Hdqrs., Ottawa, Ont., Canada. Meets, Third Tuesday. PRESIDENT, W. J. Robinson, 200½ Bank St. SECRETARY, N. J. Howes, Box 264, R.R. 1.
- **PACIFIC NORTHWEST:** 1928. Hdqrs., Seattle, Wash. **Meets, Second Tuesday.** PRESIDENT, T. C. Caskey, 11642—26th Ave., So. (88). SECRETARY, E. W. Triol, 407 Medical Arts Bldg.
- **PHILADELPHIA:** 1916. Hdqrs., Philadelphia, Pa. Meets, Second Thursday. PRESIDENT, L. M. Church, 12 So. 12th St. (7). SECRETARY, C. J. Forve, Parkwood Manor, Apt. B-202, State Rd. & Penarth Ave., Upper Darby.
- **PITTSBURGH:** 1919. Hdqrs., Pittsburgh, Pa. Meets, Third Monday. PRESIDENT, E. C. Hach, 221 Broadmoor Ave. (34). SECRETARY, E. H. Riesmeyer, Jr., 231-33 Water St. (22).
- **ROCKY MOUNTAIN:** 1944. Hdqrs., Denver, Colo. Meets, First Wednesday. PRESIDENT, V. F. Vallero, 620 12th St. SECRETARY, Duane Pearsall, 1600 W. 13th Ave.
- **SACRAMENTO VALLEY:** 1952. Hdqrs., Sacramento, Calif. **Meets, First Wednesday.** PRESIDENT, J. E. Marshall, 441 Pico Way. SECRETARY, V. W. Thornburg, 2470 27th Ave.
- **ST. LOUIS:** 1918. Hdqrs., St. Louis, Mo. Meets, Second Tuesday. PRESIDENT, G. H. Bemarkt, St. Clair Dr., R.R. 1, Caseyville, Ill. SECRETARY, W. P. Norris, 1118 Fullerton Bldg.
- **SHREVEPORT:** 1948. Hdqrs., Shreveport, La. Meets, Third Thursday. PRESIDENT, J. S. Malahy, Jr., 1839 Line Ave. SECRETARY, H. E. Scott, 2502 Woodford St.
- **SOUTH CAROLINA:** 1954. Hdqrs., Columbia, S. C. PRESIDENT, R. F. Donovan, P.O. Box 3053. SECRETARY, J. E. McMurray, 1639 Blanding St.
- **SOUTH TEXAS:** 1938. Hdqrs., Houston. Tex. Meets, Third Friday. PRESIDENT, J. W. Holland, 245 Esperson Bldg. (2). SECRETARY, J. C. Lewis, 4101 San Jacinto St. (4).
- **SOUTHERN CALIFORNIA:** 1930. Hdqrs., Los Angeles, Calif. Meets, First Tuesday. PRESIDENT, C. D. Walz, 3600 San Pasqual St., Pasadena (10). SECRETARY, H. F. Ulovec, 3886 Olympiad Dr. (43).
- **SOUTHERN PIEDMONT:** 1952. Hdqrs., Charlotte, N.C. PRESIDENT, R. S. Fullerton, P.O. Box 3697. SECRETARY, J. R. Clark, P.O. Box 1755.
- **SOUTHWEST TEXAS:** 1946. Hdqrs., San Antonio, Tex. **Meets, Third Tuesday. PRESIDENT,** L. H. Hornor, Jr., 816 Insurance Bldg. SECRETARY, Boone Crisp, P.O. Box 9065, (4).
- **TOLEDO:** 1954. Hdqrs., Toledo, Ohio. PRESIDENT, F. C. Richardson, Jr., 1938 Shenandoah Rd. (7). SECRETARY, J. F. Guest, 1815 N. 13th St. (2).
- **UTAH:** 1944. Hdqrs., Salt Lake City, Utah. Meets, Third Thursday. PRESIDENT, A. A. Maycock, P.O. Box 36 (10). SECRETARY, W. L. Stuewe, 1472 S. State St. (4).
- **VIRGINIA:** 1946. Hdqrs., Norfolk, Va. Meets, Third Wednesday. PRESIDENT, H. E. Marquart, 111 W. Main St. SECRETARY, R. L. Burton, Jr., 1913 Lafayette Blvd.
- **WASHINGTON, D. C.:** 1935. Hdqrs., Washington, D. C. Meets, Second Wednesday. PRESIDENT, G. C. F. Asker, 1109 W. Broad St., Falls Church, Va. SECRETARY, C. P. Humke, 5905 Berwyn Rd., Rt. 1, Box 89, College Park, Md.
- **WEST TEXAS:** 1953. Hdqrs., Lubbock, Tex. PRESIDENT, L. C. McKay, 210 Sanford Bldg. SECRETARY, J. C. Wharton, Box 1240.
- **WESTERN MICHIGAN:** 1931. Hdqrs., Grand Rapids, Mich. Meets, Second Monday. PRESIDENT, F. W. Brundage, 512 N. Park St., Kalamazoo (11). SECRETARY, F. L. Murray, 482 W. Michigan Ave., Battle Creek.
- **WESTERN NEW YORK:** 1919. Hdqrs., Buffalo, N. Y. Meets, Second Monday. PRESIDENT, Q. P. Thompson, 260 Richmond Ave. (22). SECRETARY, G. E. Kuhn, 475 Woodland Dr., Kenmore (23).
- **WISCONSIN:** 1922. Hdqrs., Milwaukee, Wis. Meets, Third Monday. PRESIDENT, L. C. Plaehn, 914 N. Broadway (2). SECRETARY, H. W. Alyea, 507 E. Michigan St. (2).

SPECIAL BRANCH

- **SWITZERLAND:** 1952. Hdqrs., Zurich. PRESIDENT: Walter Sennhauser, Sulzer Bros., Ltd., Winterthur. SECRETARY, Walter Hausler, Erbstrasse 2, Kusnacht, Zurich.

STUDENT BRANCHES

- **NORTH CAROLINA STATE COLLEGE:** 1948. Hdqrs., Raleigh, N. C. PRESIDENT, Norman Falbaum, Box 4668, State College Station. SECRETARY, J. L. Flowers, Apt. 33-E, Vetville.
- **OKLAHOMA A. & M. COLLEGE:** 1950. Hdqrs., Stillwater, Okla. PRESIDENT, C. E. Durrett, 1215 College. SECRETARY, R. M. Jauch, 308½ W. Maple.
- **OREGON STATE COLLEGE:** 1949. Hdqrs., Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, R. E. Bulletset, 252 Kings Rd. SECRETARY, I. P. Parkhurst, 1354 Harrison.
- **PURDUE UNIVERSITY:** 1948. Hdqrs., W. Lafayette, Ind. CHAIRMAN, E. B. Katz, 415 State St. SECRETARY, R. A. Chambers, 248 Littleton.
- **TEXAS A. & M. COLLEGE:** 1946. Hdqrs., College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, D. F. Carroll, Box 6264. SECRETARY, C. W. Farrar, Jr., Rt. 1, Box 339, Bryan.
- **UNIVERSITY OF DETROIT:** 1949. Hdqrs., Detroit, Mich. Meets, First Tuesday. PRESIDENT, J. R. Cairns, 4001 Florence, (21). SECRETARY, W. E. Zimmerman, 15359 Lauder (27).
- **UNIVERSITY OF TEXAS:** 1949. Hdqrs., Austin, Tex. Meets, First and Third Tuesday.
- **UNIVERSITY OF TORONTO:** 1951. Hdqrs., Toronto, Ont. CHAIRMAN, Alexander Tudor, 75 South Dr. SECRETARY, T. M. Devine, More House, St. Michaels College.

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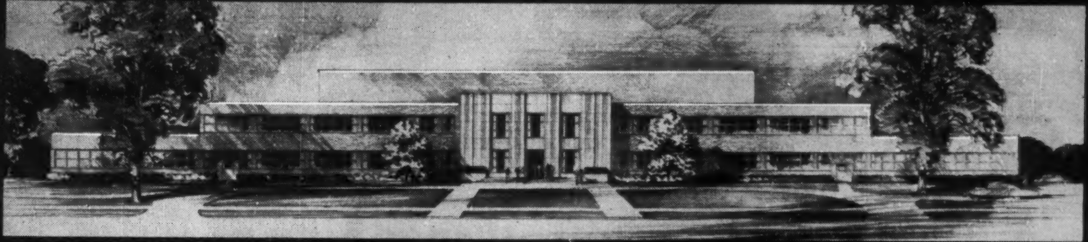
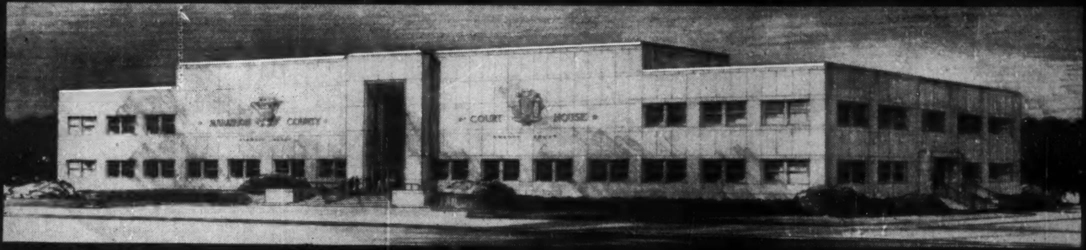
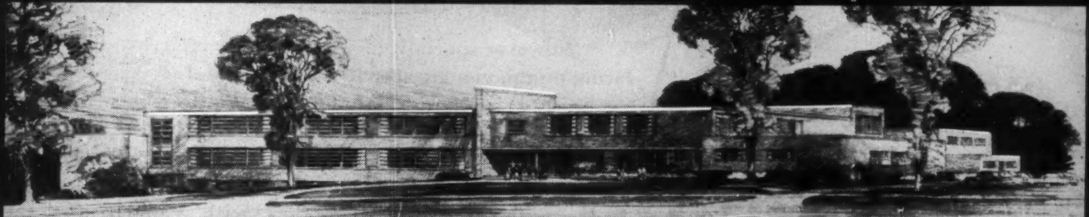


Utica Mutual Insurance Company, New Hartford, New York. Heating Contractor: A. J. Eckert Co., Albany, New York.



Marathon County Court House, Wausau, Wisconsin. Heating Contractor: R. Wenzel Co., Appleton, Wisconsin.



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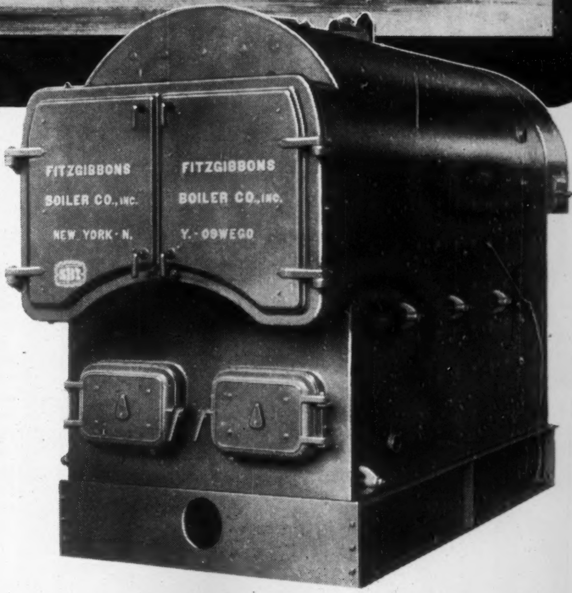

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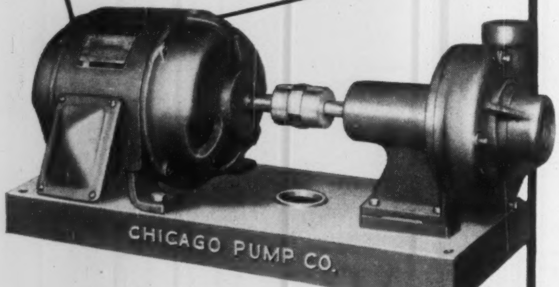

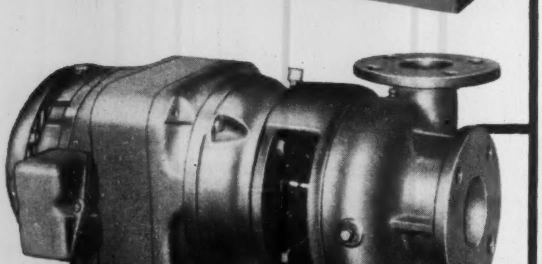

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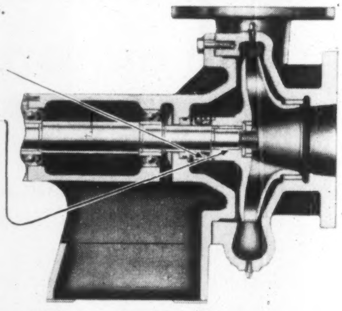

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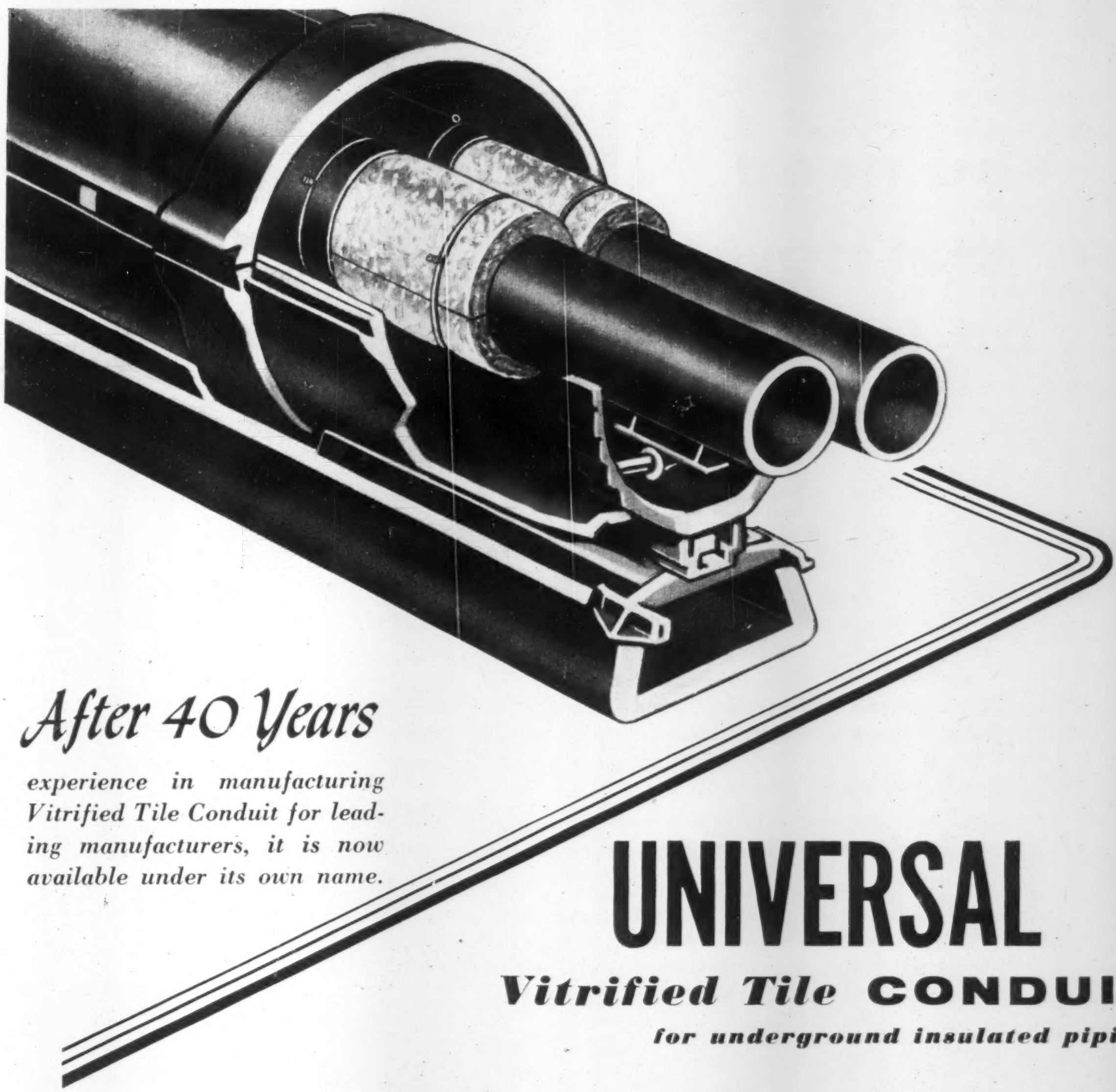

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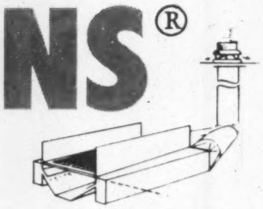

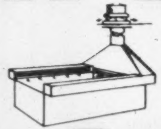

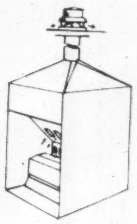

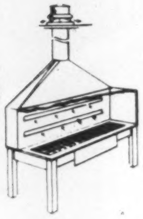

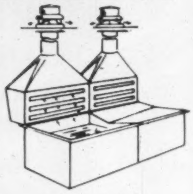

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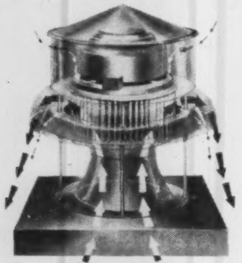

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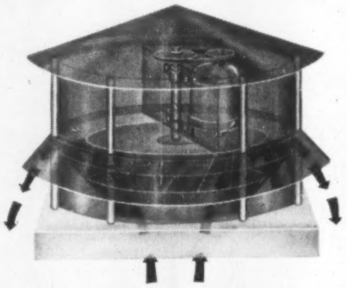

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Valve & Fitting Division
Stainless steel valves, fittings, and accessories

Aircraft Products Division
Stainless steel rings for military aircraft

Stainless Engineering and Machine Works Division
Production machining of stainless steel components

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G. E. has the answer to air conditioning problems in any office, store or factory

General Electric trained experts help Washington builder "custom-fit" air conditioning to needs of each floor

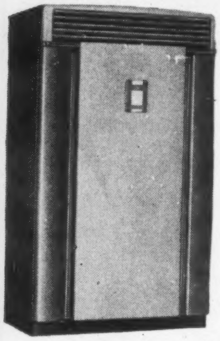
NEW 14-STORY OFFICE BUILDING at 1413 K Street, NW, Washington, D.C. A 15-ton G-E packaged air conditioner on the first floor, 7½-ton G-E units on the next three floors, and one 10-ton G-E conditioner on each of the top 10 floors provide dependable air conditioning throughout the entire building. Designer-builder: J. B. Shapiro. Contractors: Shapiro Engineering Corporation. Consulting Engineers: General Engineering Associates.

Floor area alone is just the beginning when it comes to criteria for determining the amount of air conditioning to provide, and the best location for supply units. That's why J. B. Shapiro, Washington designer-builder, asked his local G-E air conditioning contractor to help him plan the "weather" for Washington's first 14-story office building. G-E trained experts took into consideration all the detailed factors that account for heat gains and losses—even exposure to sunlight, elevator traffic, and nature of tenants' businesses—before making recommendations that resulted in effective, low-cost air conditioning for each floor.

ASK FOR G-E CLIMATE SURVEY

At no cost to you or your clients, your G-E dealer will make a thorough analysis of the air conditioning needs of existing buildings, or work with you from blueprints to air condition new structures.

LOOK AT ALL THE ADVANTAGES OF USING G-E PACKAGED AIR CONDITIONERS



- Low in installation and operating costs.
- 3, 5, 7½, 10 and 15 ton units in single or multiple for any size building.
- Maximum design freedom—use in space or concealed, with or without ducts.
- Streamlined styling blends with any decor.
- Easily directed air flow for no-draft, no-waste air circulation.
- Muggy Weather Control removes excess moisture without overchilling.
- G-E factory assembled. 5-year warranty covers entire sealed cooling system.

Write for complete architectural data.
General Electric Company
Commercial & Industrial Air Conditioning Dept., Bloomfield, N. J.

Packaged AIR CONDITIONERS

Progress Is Our Most Important Product

GENERAL ELECTRIC

A pipe dream come true!

Made in pre-formed sections, new Fiberglas Low Pressure Pipe Insulation is easily and economically applied. Comes in sizes to fit standard pipe up to 12", all copper tubing up to 3" in diameter. Suitable finishes, including vapor barrier jackets for cold line anti-sweat purposes, *are factory applied.*

New, rot-proof, shrink-proof, high thermal efficiency

FIBERGLAS* LOW PRESSURE PIPE INSULATION

for low pressure steam lines, hot and cold water lines!

The problem is solved—no more rotting, shrinking, adsorbent, *costly* insulation on your low pressure steam lines, your hot and cold water lines!

New Fiberglas Low Pressure Pipe Insulation is here—the first major improvement in low pressure pipe insulation in over 30 years—tested and proved in three years of trial applications!

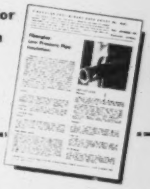
Made of inert fibers of glass, this pipe dream come true will not rot, shrink, swell, buckle, or sag. It's lightweight, resilient, moisture resistant, *and up to 50% more efficient thermally than old insulations used in low pressure service.* Best of all . . .

New Fiberglas Low Pressure Pipe Insulation is priced right in line with ordinary insulations!

Which means that for any given installation it's actually cheaper. For thanks to higher efficiency, ½" of Fiberglas Low Pressure Pipe Insulation does the same insulating job on hot piping as 1" of less efficient old type insulation—and it lasts and lasts. The properly located vapor barrier (on outside of insulation) helps avoid condensation, adsorption and resultant corrosion of pipe and deterioration of insulation.

Whatever the application—low pressure steam, hot water or anti-sweat for cold water lines—Fiberglas Low Pressure Pipe Insulation pays for itself time and time again. Moreover, it's easy to cut and handle, fast and economical to install.

Mail coupon now for new 4-page bulletin giving full technical data!



OWENS-CORNING
FIBERGLAS
T.M. REG. U.S. PAT. OFF.

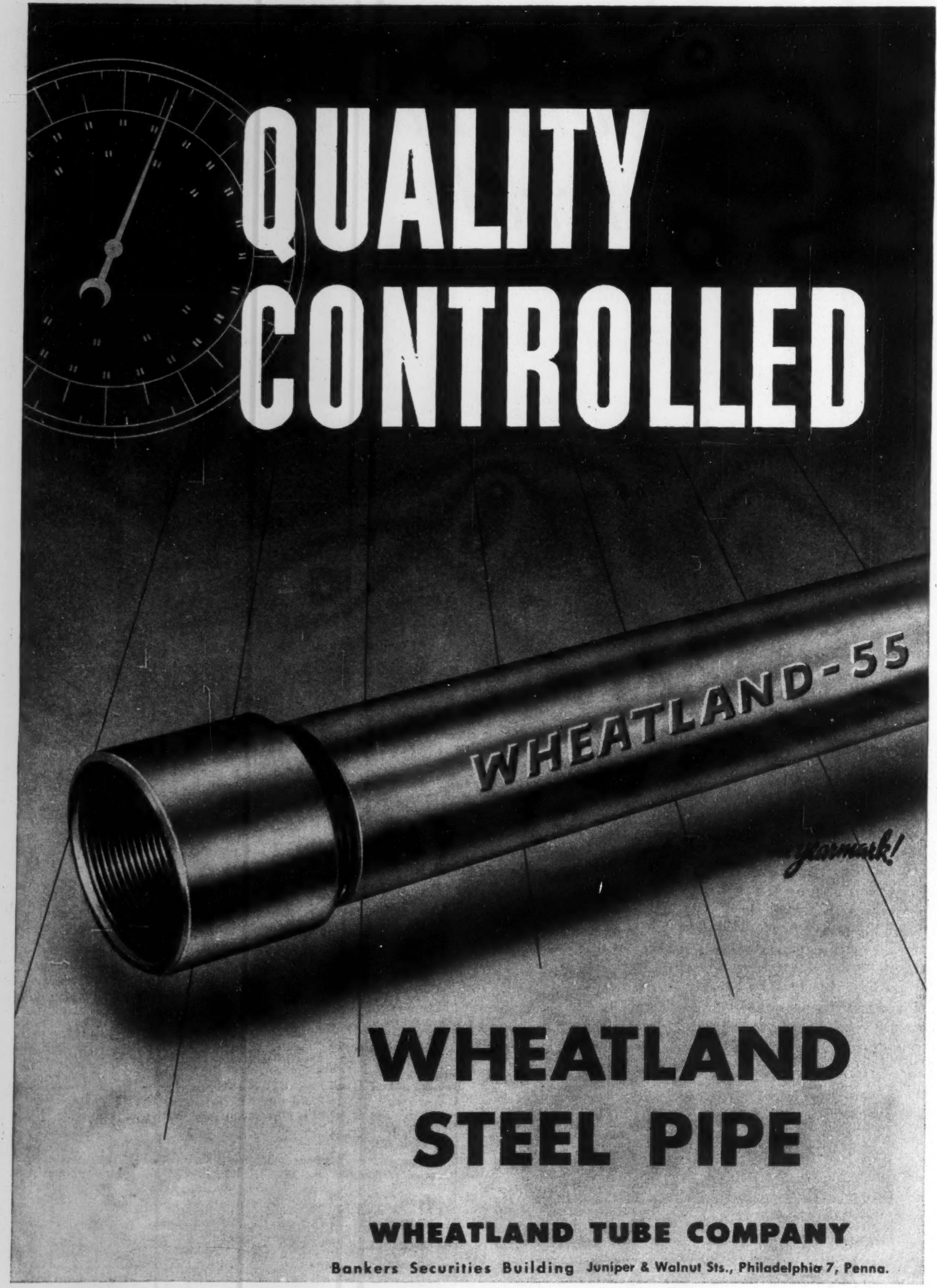
*T. M. Reg. U. S. Pat. Off.

PIPE INSULATIONS • ROOF INSULATIONS • DUCT INSULATIONS
EQUIPMENT INSULATIONS • LOW TEMPERATURE INSULATIONS

Owens-Corning Fiberglas Corporation
Dept. 50-K
Toledo 1, Ohio

Please send me a free copy of your new 4-page technical bulletin on new, rot-proof, shrink-proof, high efficiency Fiberglas Low Pressure Pipe Insulation.

Name. . . . .
Position. . . . .
Company. . . . .
Street. . . . .
City. . . . . **Zone**. . . . . . **State**. . . . .


QUALITY
CONTROLLED
WHEATLAND-55
yearmark!

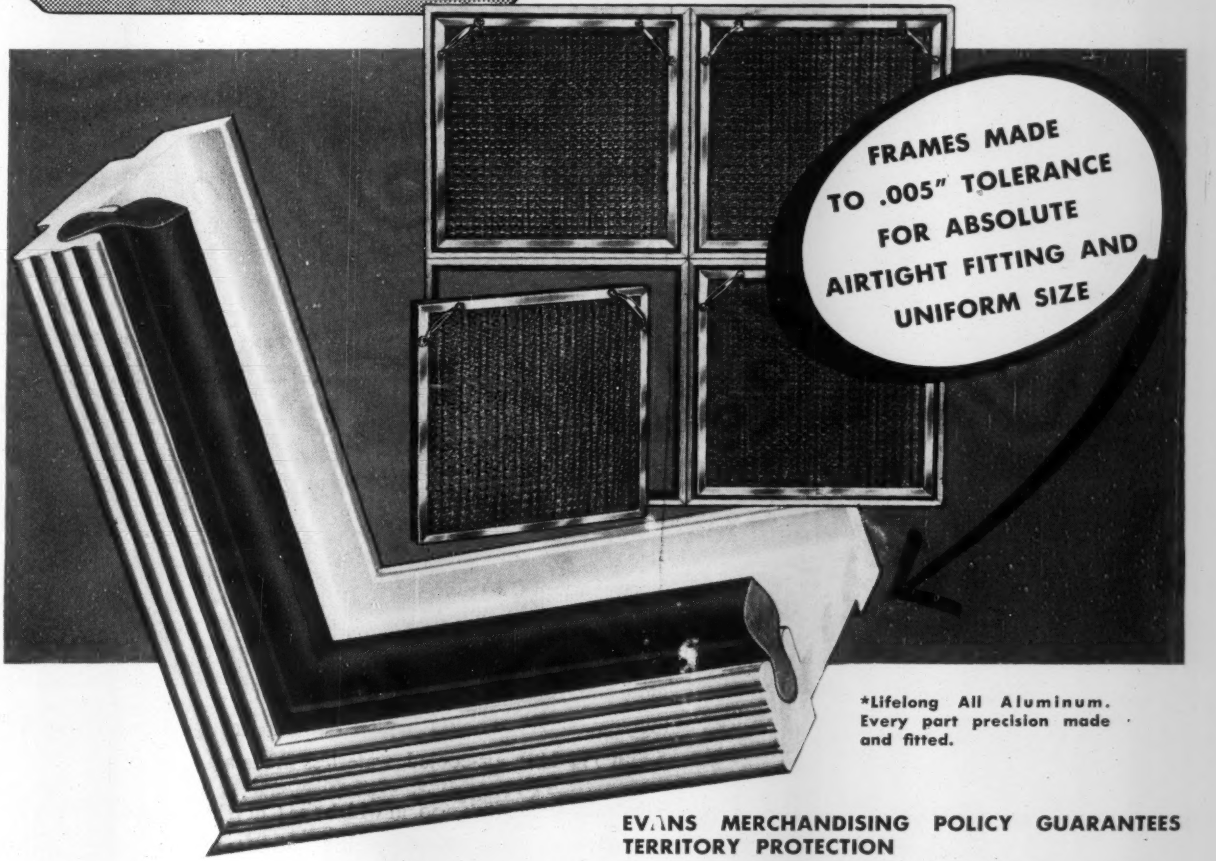
WHEATLAND STEEL PIPE

WHEATLAND TUBE COMPANY

Bankers Securities Building Juniper & Walnut Sts., Philadelphia 7, Penna.

NEW . . . INDUSTRIAL

Evans Filters & Frames



FRAMES MADE TO .005" TOLERANCE FOR ABSOLUTE AIRTIGHT FITTING AND UNIFORM SIZE

***Lifelong All Aluminum. Every part precision made and fitted.**

EXTRA RIGIDITY HOLDS TRUE DIMENSION AND ALIGNMENT UNDER HEAVIEST STRESS

Made of high strength aluminum alloy. Extruded for superior strength, and highest dimensional accuracy. Filter and frame unit is light. Can be carried anywhere. Easily handled. Weight (including filter, frame, handles, gasket) 16 lbs. 4 oz.

MOLDED NEOPRENE GASKET STOPS AIR AND DUST BY-PASS

Precision manufactured interlocking construction prevents air leakage. Provides proper cushioning for positive sealing. Allows easy removal of filter without releasing dust to air stream.

AS SIMPLE TO PUT TOGETHER AS AN ERECTOR SET

No complicated parts. No complicated instructions. Cuts assembly time to one-half that of conventional type frames.

EVANS MERCHANDISING POLICY GUARANTEES TERRITORY PROTECTION

Adds profits, sales, gives new greater customer satisfaction.

Investigate Now!

MAIL THIS COUPON TODAY!

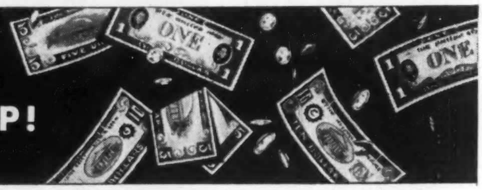
The George Evans Corp. **Moline, Illinois**

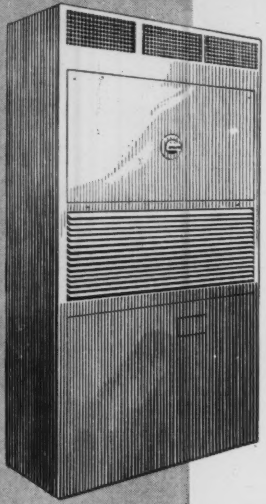
GENTLEMEN: Please send me: ☐ **Descriptive Literature**
☐ **Merchandising Policy** ☐ **Price Lists**

I WANT TO LEARN HOW TO MAKE MORE MONEY OUT OF THE FILTER BUSINESS.

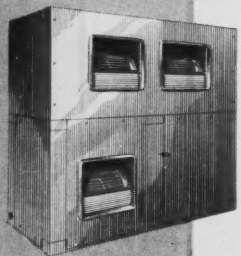
Name .... **Company** ....
Address ....
City .... **State** ....

There's money in the air...
when you sell **CHRYSLER AIRTEMP!**





"Packaged" Water-Cooled Air Conditioners in 6 models, from 2 to 15 H.P.



"Packaged" Waterless Air Conditioners—no water needed, no plumbing required. 2, 3, 5 and 7½ H.P.

are you prepared to sell any job?

HERE'S EVERYTHING YOU NEED!

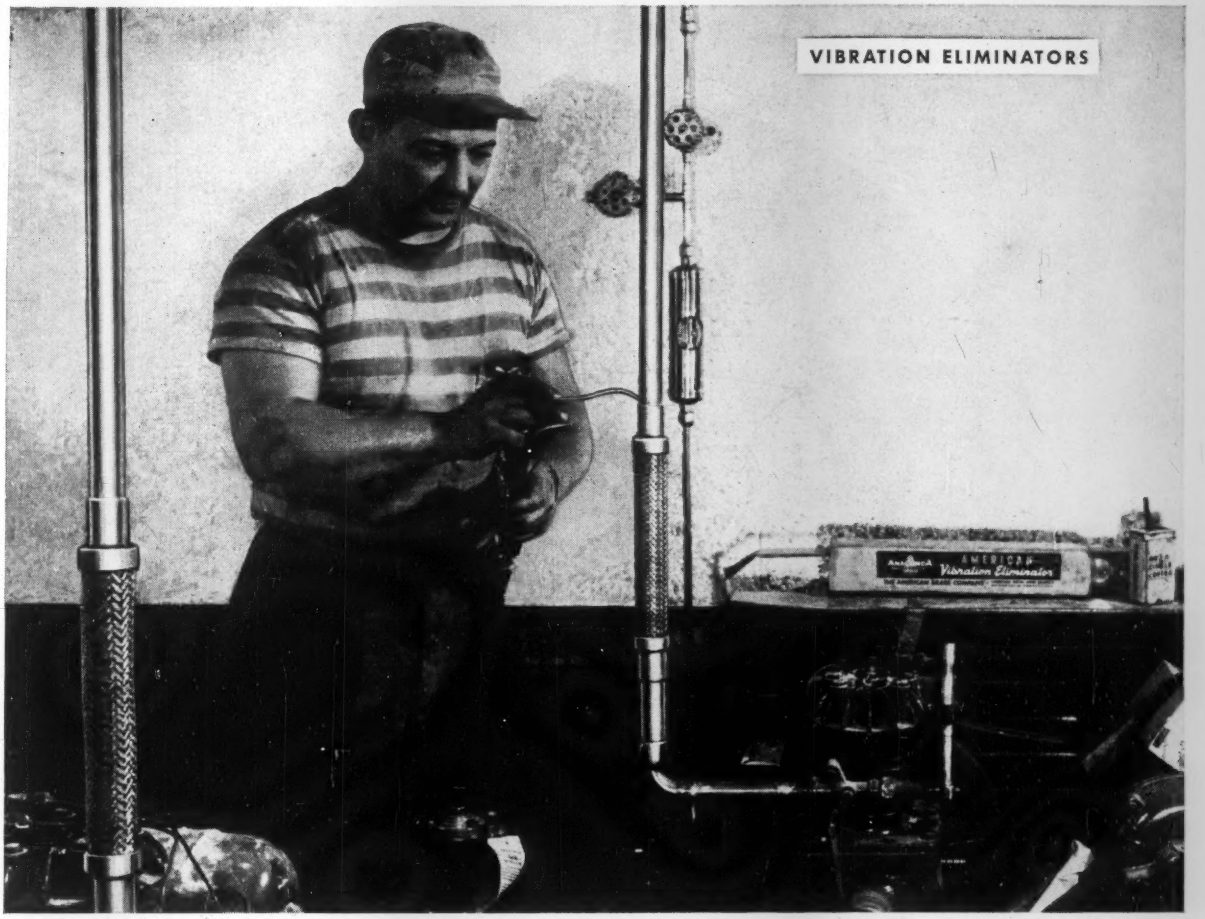
You can meet all the requirements of *any* job—when you sell Chrysler Airtemp "Packaged" Air Conditioning! It's the *complete* line with 6 water-cooled and 4 waterless models. The air-cooled, waterless models have been proved in thousands of installations. And only Chrysler Airtemp has 5 and 7½ H.P. air-cooled, waterless models.

There are other ways, too, in which the Chrysler Airtemp Franchise can give you competitive advantages that will pay off in more sales of "Packaged" air conditioning. Write today for complete details. Airtemp Division, Chrysler Corporation, Dayton 1, Ohio.

CHRYSLER AIRTEMP
DIVISION OF CHRYSLER

Air Conditioning's other name... Chrysler Airtemp

AIR CONDITIONING • HEATING FOR HOMES, BUSINESS AND INDUSTRY


VIBRATION ELIMINATORS
AMERICAN
Vibration Eliminator

THREE BROTHERS, Myron, Edmond and Ernest, own and operate AAA Refrigeration Service, Inc., 1804 Nereid Ave., Bronx, N.Y. Above, Ernest connects one of 23 American VE's—ranging in size from ¾" to 1⅛"—used in refrigeration system for large supermarket.

"We've used American Vibration Eliminators for 6 years . . . have never had to replace one"

—says Ernest Steffen, AAA Refrigeration Service, Inc.

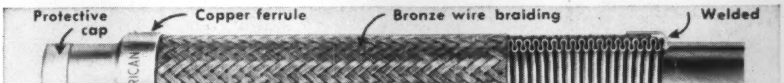
"Over the past 6 years we've installed hundreds of American Vibration Eliminators in refrigeration and air-conditioning systems. Not a one has ever given us any trouble," continues Mr. Steffen.

He goes on to say, "We can't afford to let vibration in rigid piping go uncontrolled. Chances are it would mean objectionable noise, cracked piping, high maintenance costs—*and* dissatisfied customers.

"That's why we always install an American Vibration Eliminator in the rigid piping above the compressor. These flexible connectors allow for expansion and contraction in rigid lines. They dampen vibration, muffle noise. And they're leakproof . . . guard refrigerant lines against fatigue-cracking."

Take a tip from AAA Refrigeration. Use quality American Vibration Eliminators to control vibration in rigid piping. Leading wholesalers stock packaged American VE's to fit standard copper tube sizes. For more information, write for Bulletin VE-310R to: The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.

54229

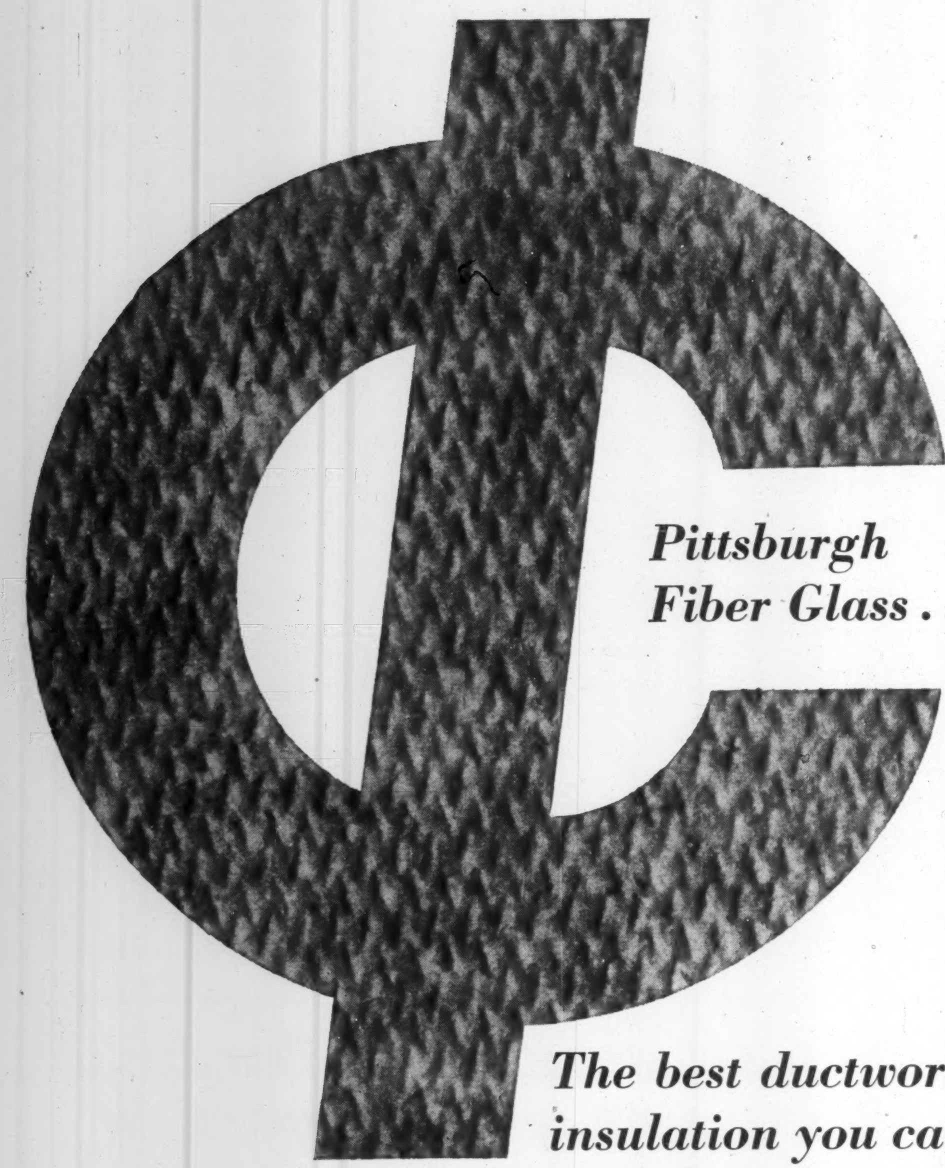

Protective cap
Copper ferrule
Bronze wire braiding
Welded
AMERICAN
Copper tube end
Seamless flexible bronze tubing (98¾ % copper, 1¼ % tin)

American VE's have *seamless* cores. No laps. No joints . . . made from phosphor bronze seamless tube.

for American Vibration Eliminators see your

ANACONDA®

DISTRIBUTOR



Pittsburgh Fiber Glass . . .

The best ductwork insulation you can use costs less to install!

Besides its superior thermal and acoustical insulation qualities, Pittsburgh Superfine Fiber Glass Insulation is extremely easy to install as either duct liner or duct wrap . . . saves dollars for you on labor costs.

PPG Superfine is easily cut to shape with either knife or shears, fits all ductwork shapes easily. Applied with either adhesives, tapes, cord or wire, PPG Superfine's complete range of insulation thicknesses can be supplied with cloth, asbestos, paper, aluminum foil or vinyl facings to serve the specific requirements of any application.

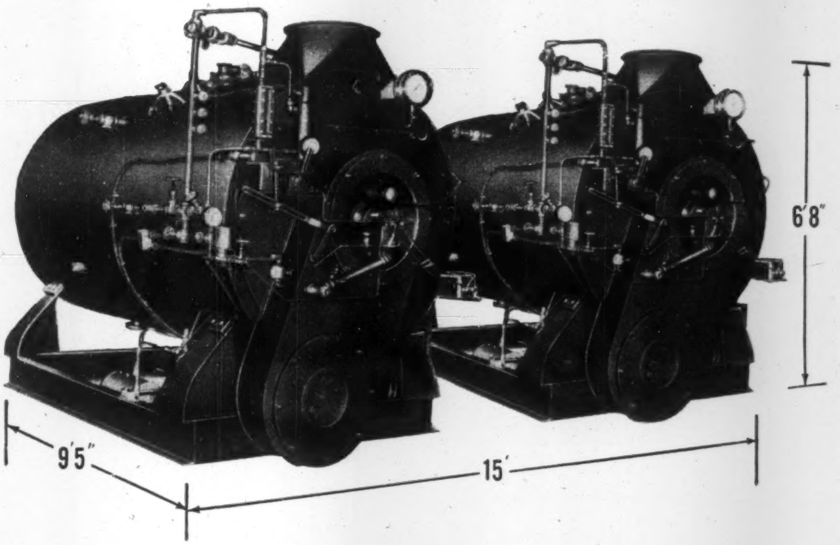
Be sure to get complete facts on the unusual economies and quality insulation values that Pittsburgh Superfine Fiber Glass can provide your ductwork system. Write our executive offices or our district sales offices in Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia or St. Louis. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

FIBER PPG GLASS

PAINTS · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY

9600 lbs. of Steam in only 1000 cu. ft!



Using only 140 sq. ft. of Floor Space

The Cyclotherm MC4000 Steam Generator allows you to utilize your space more efficiently . . . to devote more of your area to storage and production use.

Requires the minimum in boiler room space and costs. Or can be placed in a working area because radiant heat loss is at a minimum. Exclusive, patented, Cyclotherm Cyclonic Combustion makes the most compact steam generator yet developed possible.

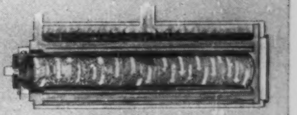
A flaming cyclone swirls the length of the firetube . . . separated from the walls only by a thin layer of air. The even distribution of the flame converts the entire surface of the firetube into an effective heating area. Without increasing the boiler size, the heating area has been enlarged to the maximum.

No other method of combustion can equal this accomplishment. The Cyclotherm MC4000 is ideally suited for service wherever steam is needed but boiler room space is at a premium.

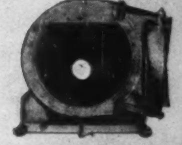
See Cyclotherm's new
MC4000 Steam Generator at the
CYCLOTHERM EXHIBIT
Booth 450, 21st Power Exposition,
Philadelphia, Dec. 2-7

YEARS AHEAD
IN STEAM
GENERATION
CYCLOTHERM®
STEAM AND HOT WATER GENERATORS

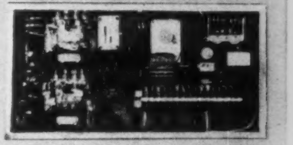
Cyclotherm Division, U. S. Radiator Corp., Dept. 326, Oswego, New York



Exclusive, patented Cyclonic Combustion gives you a minimum guaranteed 80% efficiency in only 2 passes . . . a rate unequalled by any other method of combustion.



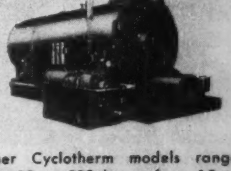
Simplified design shaves maintenance costs up to 50%. Cleaning and replacement of parts can be done in minutes by any maintenance man. Firetube never needs cleaning as all fuel is consumed.



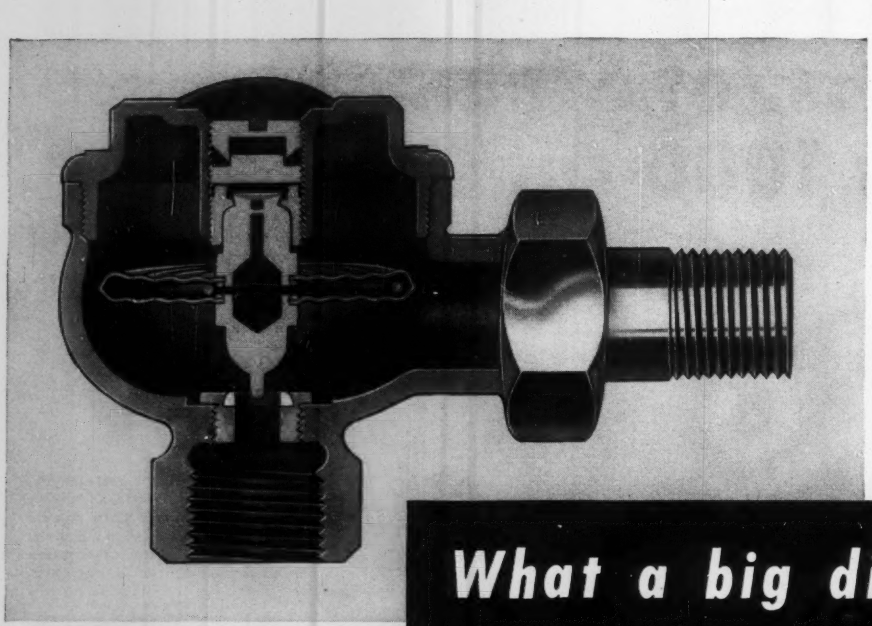
Automatically operates by electronic control system. No fireman required. Burns gas and/or oil. A Cyclotherm unit will pay for itself in 4½ years in fuel savings alone.

Precision modulation equipment regulates firing rate from 30 to 100% of the Cyclotherm's capacity without losing peak efficiency.

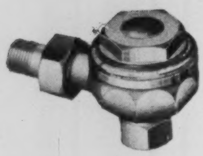
Now aboard Sinclair Refining Co.'s "Sinclair Chicago," and U. S. Navy's "U. S. S. Endurance." . . . operating efficiently in space too cramped for ordinary packaged units.



Other Cyclotherm models range from 18 to 500 hp . . . from 15 to 200 psi. For industrial, commercial plants, institutions and marine use.

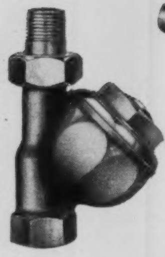


What a big difference a trap can make!

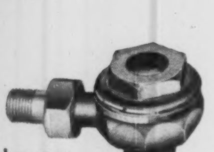


Angle

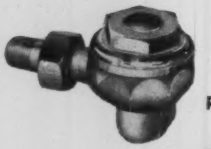
Straightway



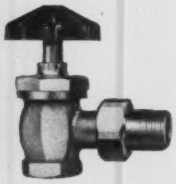
Vertical



Left hand corner



Right hand corner



Marsh Packless Radiator Valves are perfect team mates for Marsh Radiator Traps. The metal-to-metal seal places them in a class all their own.

Yes, the success or failure of a steam distribution system can hinge on things as small as radiator traps. That's why it pays to use Marsh Radiator Traps—traps that are individually and permanently adjusted to close tight on steam, but open promptly and pass air or condensate at temperatures only a few degrees below closing temperature.

The part that provides positive operation in Marsh Radiator Traps is that rugged-but-sensitive thermostatic diaphragm. After this element has been assembled it is made completely seamless by a heavy overall deposit of copper. It is then filled with an accurately measured charge of volatile fluid; finally tested by expert operators to make sure that its expansion and contraction is exactly right to produce the utmost efficiency and economy.

Construction throughout is in keeping with the effective diaphragm. Bodies are of extra heavy cast brass suitable for pressures up to 125 lbs. steam. Bonnet assemblies of a given type and size are interchangeable. Trap seats are renewable. All components are made with a large safety factor beyond rated operating pressures.

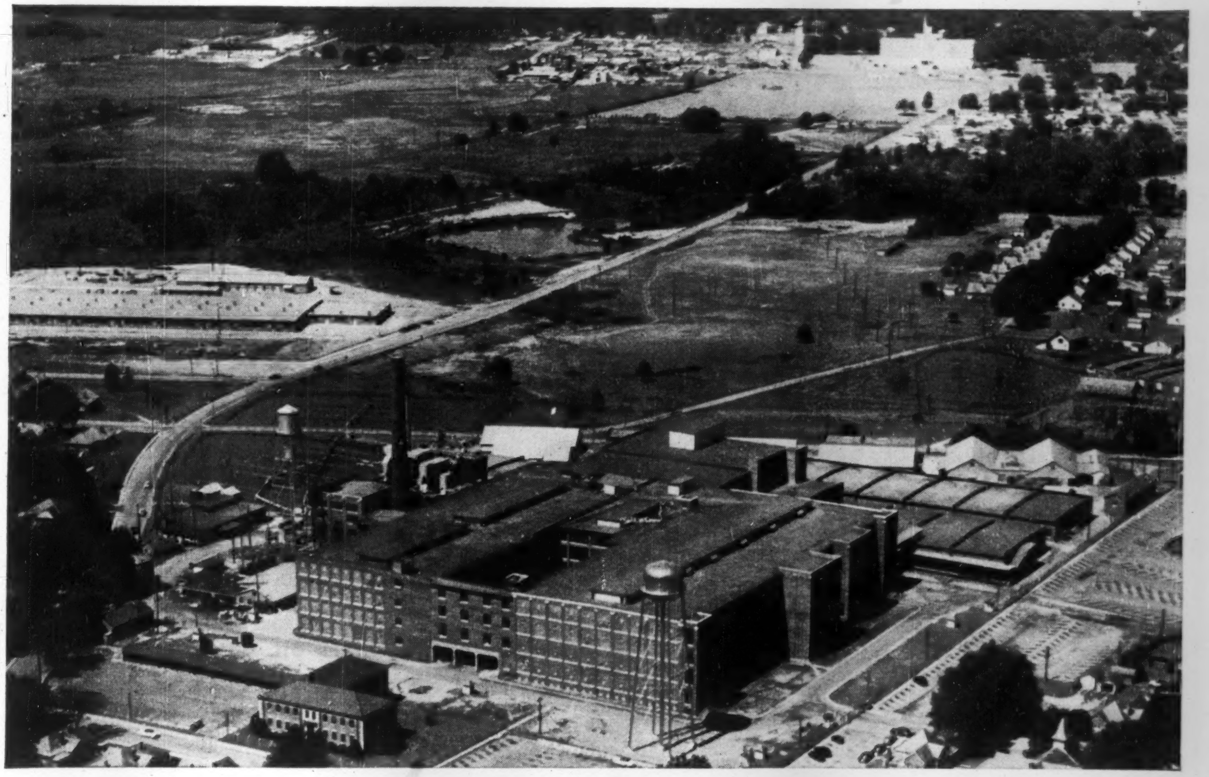
Next time make it Marsh throughout and see the difference . . . Marsh traps, packless valves, bucket traps, venting valves. All are covered in the new fact-filled catalog.

MARSH HEATING EQUIPMENT CO.
Sales affiliate of Jas. P. Marsh Corporation
Dept. T, Skokie, Illinois

MARSH
Heating Specialties **SINCE 1865**

Oh, I see

The Mathews plant of Greenwood Mills, Greenwood, South Carolina. The large building in the background is the modern Self Memorial Hospital erected by J. C. Self, Greenwood Mills' president.



. . . they're using our valves at the Greenwood Textile Mills

Machined parts of OIC Valves are tested to meet close measures of tolerance. Their proper fit provides positive closure with little effort by the operator. Also, it contributes toward longer valve service life.

Each valve in the complete line of modern OIC Valves is machined with this same close precision. That's one reason why so many of them are being used at the Greenwood Textile Mills . . . and at other plants throughout the industry.

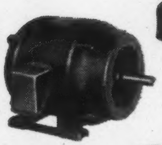
Contact your authorized OIC Valve distributor for valving assistance. And for quick valve selection, write for the OIC Catalog Digest.

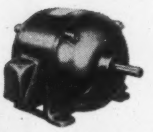
THE OHIO INJECTOR COMPANY • Wadsworth, Ohio

OIC
FOUNDED 1883

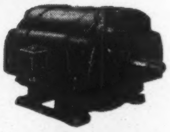
VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES**

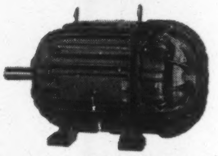
It's top-quality equipment if it has... ELLIOTT CROCKER-WHEELER MOTORS



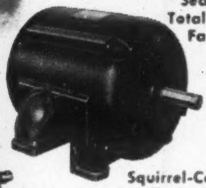


Squirrel-Cage
Drip-proof Type
Splashproof Type

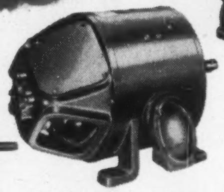




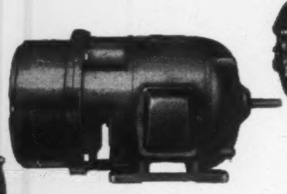
"Sealedpower"
Totally-Enclosed
Fan-cooled



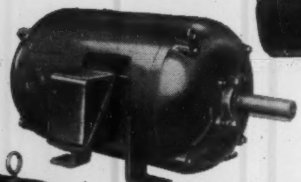
Squirrel-Cage
Totally-Enclosed
Non-Ventilated



DC Open Type (illustrated), Drip-proof.
Also Drip-proof Guarded

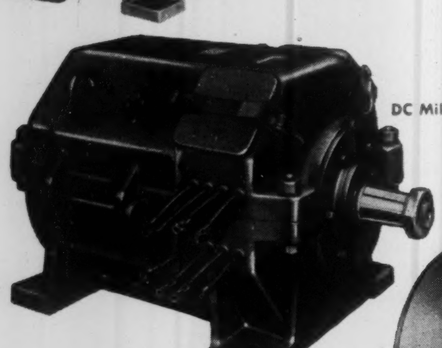


Brake Motor



Wound-Rotor
Drip-proof Type

Explosion-Proof
"Sealedpower"



DC Mill Motor

- Like the sterling mark on silver, an Elliott Crocker-Wheeler motor on a machine tool, pump, fan, textile machine, is a positive indication of the quality which the machine builder has put into his product.

The Elliott C-W line of integral motors is complete, covering a range of 1 to 200 hp, all types available including the new Elliott C-W Gearmotor.

Your local Elliott representative will give you all the facts—or write Elliott Company, Crocker-Wheeler Division, Ampere, N. J.

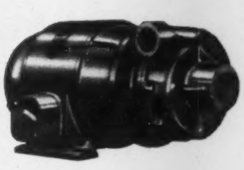
ELLIOTT Company
CROCKER-WHEELER DIVISION

Gearmotor.
Single reduction
with brake.

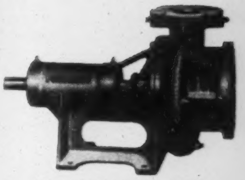
W3-11

How to Save

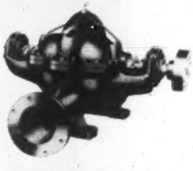
TIME \ MONEY \ ENERGY



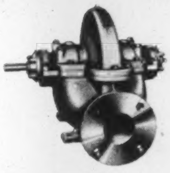
TYPE PE FLUIDYNE INTEGRAL HP PUMPS
A complete line of electric close-coupled general purpose pumps. Threaded or flanged connections. Capacities: to 800 gpm; heads: up to 260 feet; motors: up to 50 h.p.



TYPE PB FLUIDYNE GENERAL PURPOSE PUMPS
Flexible coupled, single-stage, end suction, general purpose pumps. Rugged and durable. Capacities: up to 5500 gpm; heads: up to 260 feet; motor: up to 150 h.p.

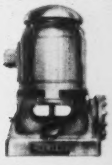


TYPE A GENERAL PURPOSE PUMPS
For application to the widest variety of pumping conditions. Single stage split case design. Capacities: up to 70,000 gpm; heads: to 300 feet. All types of drive.

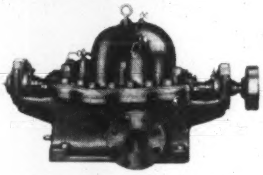


TYPE AS GENERAL PURPOSE PUMP
The centrifugal pump with mechanical shaft seals that eliminate the packing box. Up to 4" in discharge sizes. Capacities: up to 750 gpm; heads up to 210 feet.

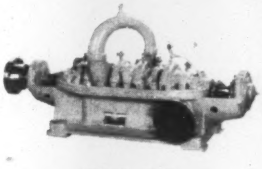
BY BUYING FROM THE COMPLETE LINE



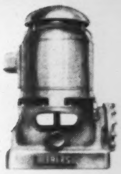
VERTICAL DEEP WELL TURBINE PUMPS
For application to deep well pumping. Lifts from 1000 feet or more. Capacities: up to 30,000 gpm. H.P. range: up to 1000 h.p. oil and water lubricated types. Widest range of sizes.



TYPE TU BOILER FEED AND PROCESS PUMP
2-stage high pressure pump for water and other liquids. Capacity: 50 to 3500 gpm; heads: up to 600 feet. Internal cross over is built into top half of pump case.

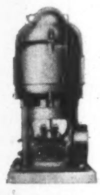


TYPE TUT MULTI-STAGE PUMPS
3, 4 and 5-stage pumps for water handling and process services. 1" to 5" discharge sizes. Capacity: up to 1350 gpm; head range: up to 1600 feet. Split case design.



INDUSTRIAL SERVICE PUMPS
For application to pits, sumps, basins, reservoirs and other surface water sources. Same capacity as deep well turbine above. H.P. range: up to 2500 h.p.

HYDRO-LINE PUMPS
An enclosed, close-coupled, vertical centrifugal process pump for handling petroleum hydrocarbons, where NPSH is limited. Capacities: to 6000 gpm; heads: to 1500 feet.



HI-LIFT PUMPS
The unique positive displacement deep well pump that literally squeezes water upward. Capacity: 10 to 55 gpm; lifts: up to 1000 feet. For wells 4" in diam. and up.

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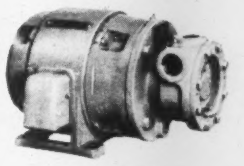
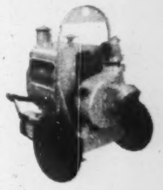


TYPE TVE & TVB TURBINE VANE PUMPS
Standard and self-priming, close-coupled and flexible-coupled pumps for hot and cold, clear and vaporous liquids. Capacities: up to 58 gpm; heads: up to 800 feet.



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Air-Factors B60 Series Air Diffusing Ceiling Outlets are custom designed to suit specific job conditions. The patented construction provides for an egg crate air straightening core directly behind and integral with flexible counterflow air diffusing vanes that permit on-the-job alterations to the air mixing qualities of the outlet. The flexible secondary air deflecting vanes that also are an integral part of the diffusing core permits additional on-the-job adjustments to the air discharge angle from the ceiling.

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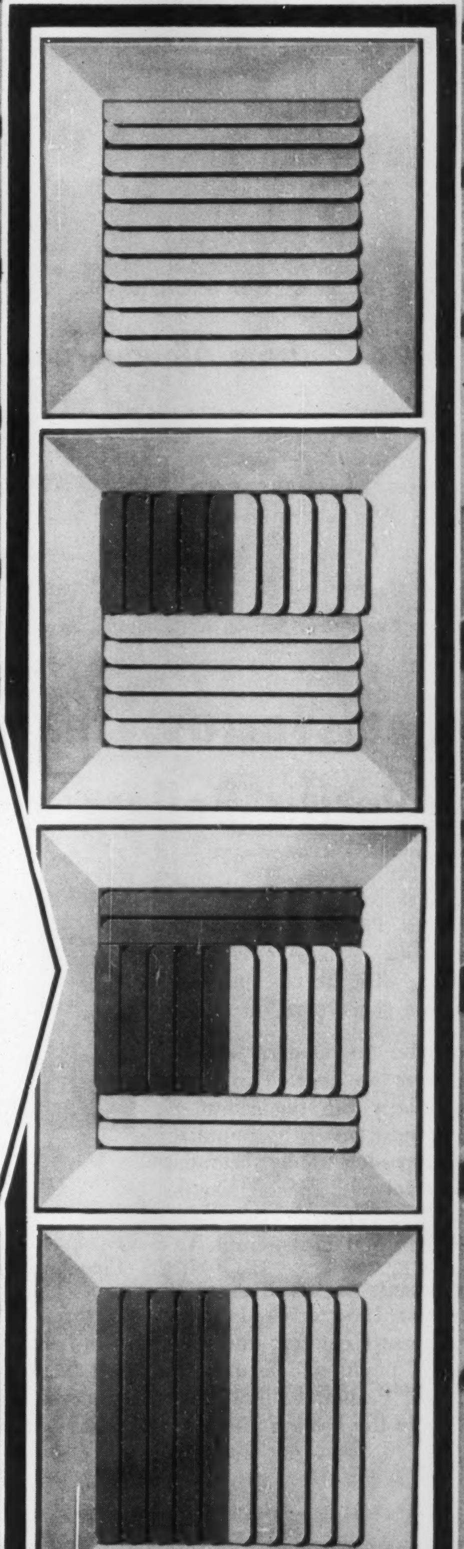

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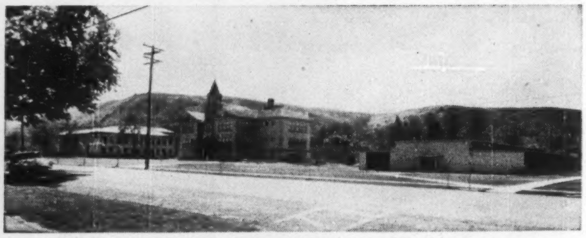
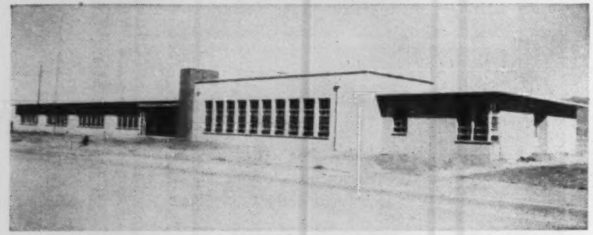
John J. Lynch Junior High School, Holyoke, Mass.

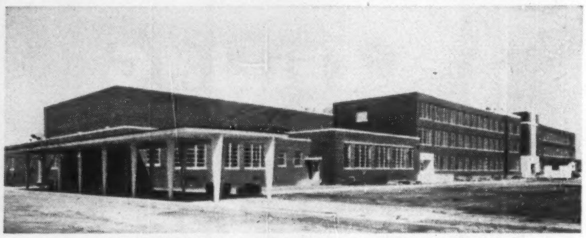


Dayton Public School, Spokane, Washington

. . . from Albuquerque, New Mexico to Portsmouth, Virginia . . .



Montezuma Elementary School, Albuquerque, New Mexico



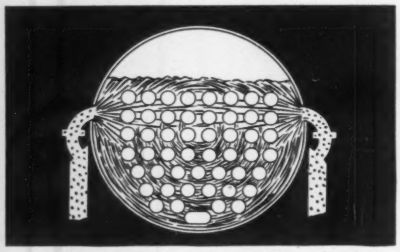
Cradock High School, Portsmouth, Virginia

Schools across the nation choose Pacific Boilers with *Jet-action* Circulation!

In schools across the nation, the swing is to Pacific Boilers. The reason: Pacific's exclusive *Jet-action* Circulation, with its efficient heat transfer and economical operation.

For example, the modern schools shown above are located in cities that practically run the gamut of climatic conditions to be found in the U.S.—in such widely separated cities as: Holyoke, Massachusetts; Spokane, Washington; Albuquerque, New Mexico; and Portsmouth, Va.

In each case, the architecture is modern and functional—designed for the greatest comfort and convenience of pupils and faculty. In each case, Pacific Boilers were chosen to do the heating job.



Exclusive *Jet-action* Circulation

You see this, more and more. Fact is, Pacific Boilers with *Jet-action* Circulation are fast becoming *standard equipment* in schools.

For *Jet-action* Circulation, Pacific's outstanding advance in boiler engineering, cuts fuel costs—permits nearly instant response when a change in temperature is desired. The secret? Pacific's exclusive jet connections, which project a high-speed stream of steam and water across the heating tubes. This turbulent "washing" action sweeps tubes clean of clinging, heat-insulating bubbles. Tubes absorb heat faster; fuel consumption is lowered.

You can pass these benefits along to *your* customers: simply specify Pacific Boilers with *Jet-action* Circulation. They're quickly and easily installed. And they come in all sizes, using all fuels, for all types of buildings.

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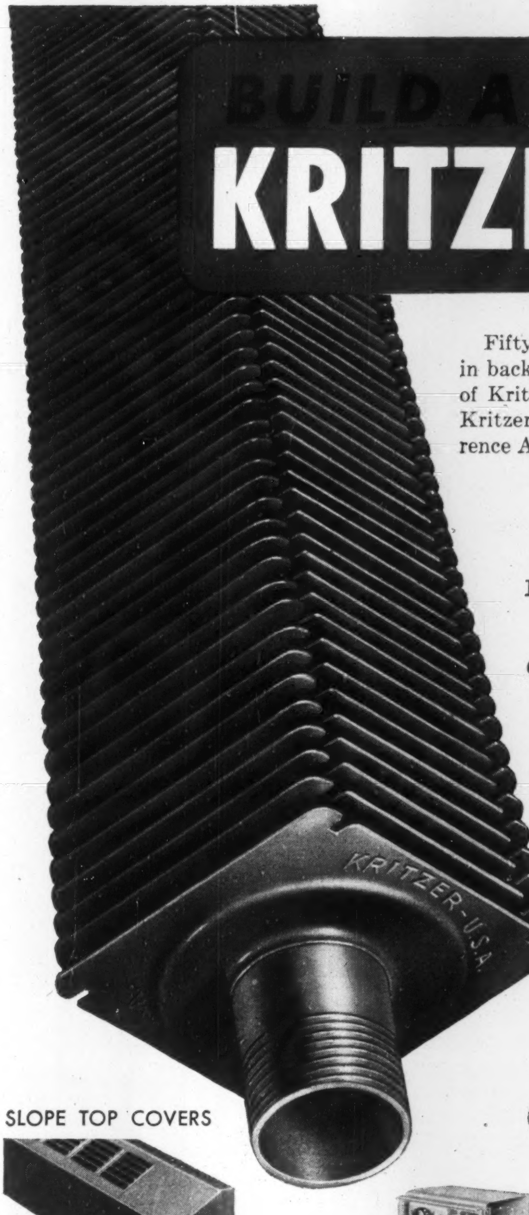

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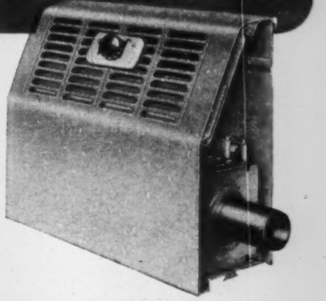
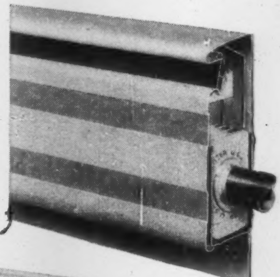
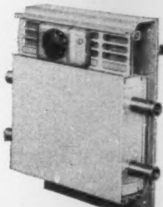


SLOPE TOP BASEBOARD



"K" LINE BASEBOARD



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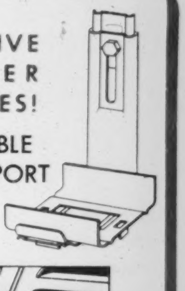
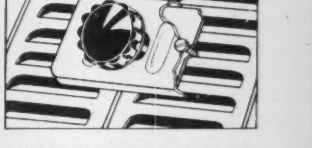


ADJUSTABLE COIL SUPPORT BRACKET



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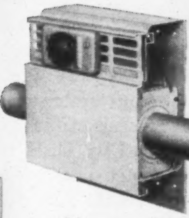
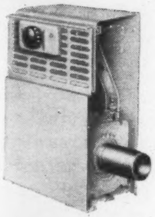
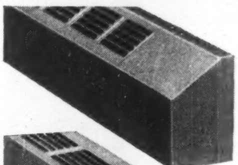


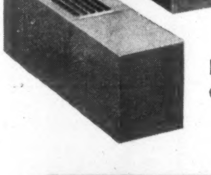
UNIVERSAL BASEBOARD



CONVECTOR, SLOTTED FRONT

SLOPE TOP COVERS





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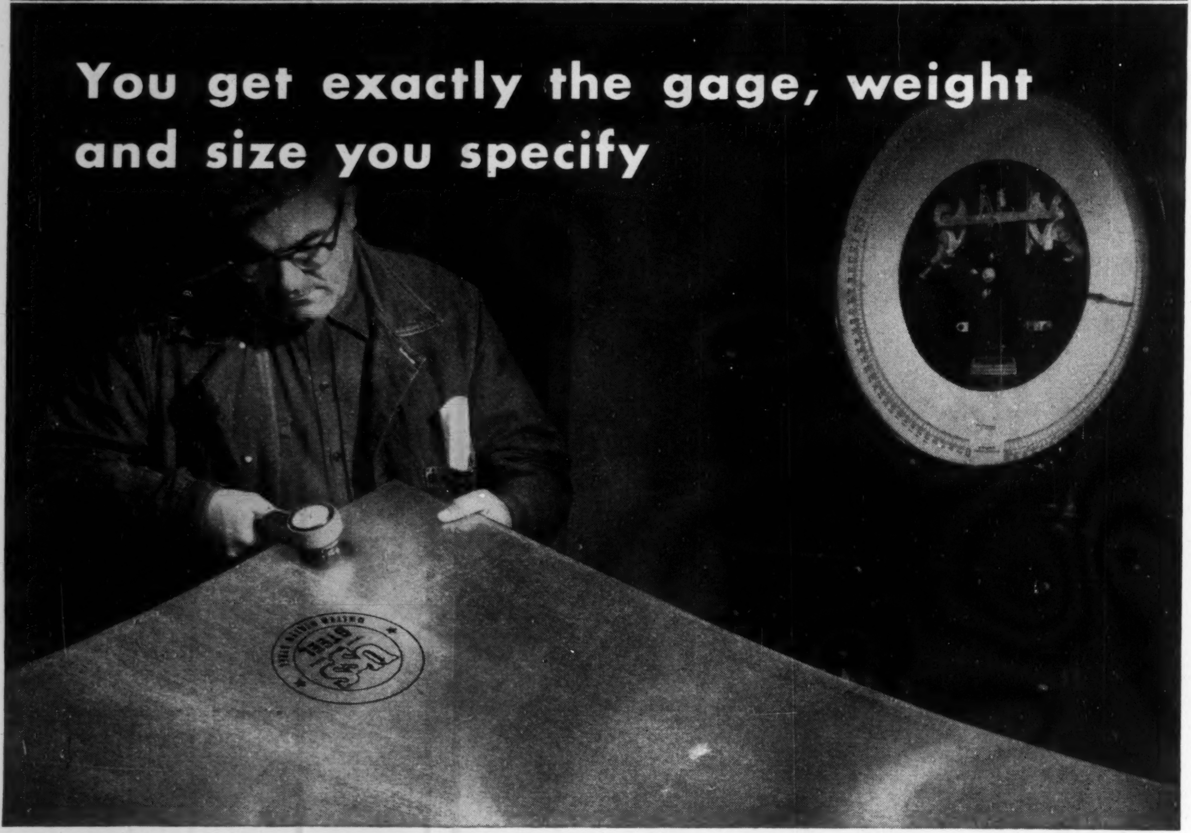

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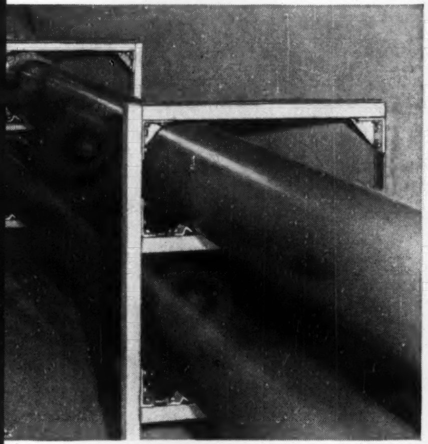
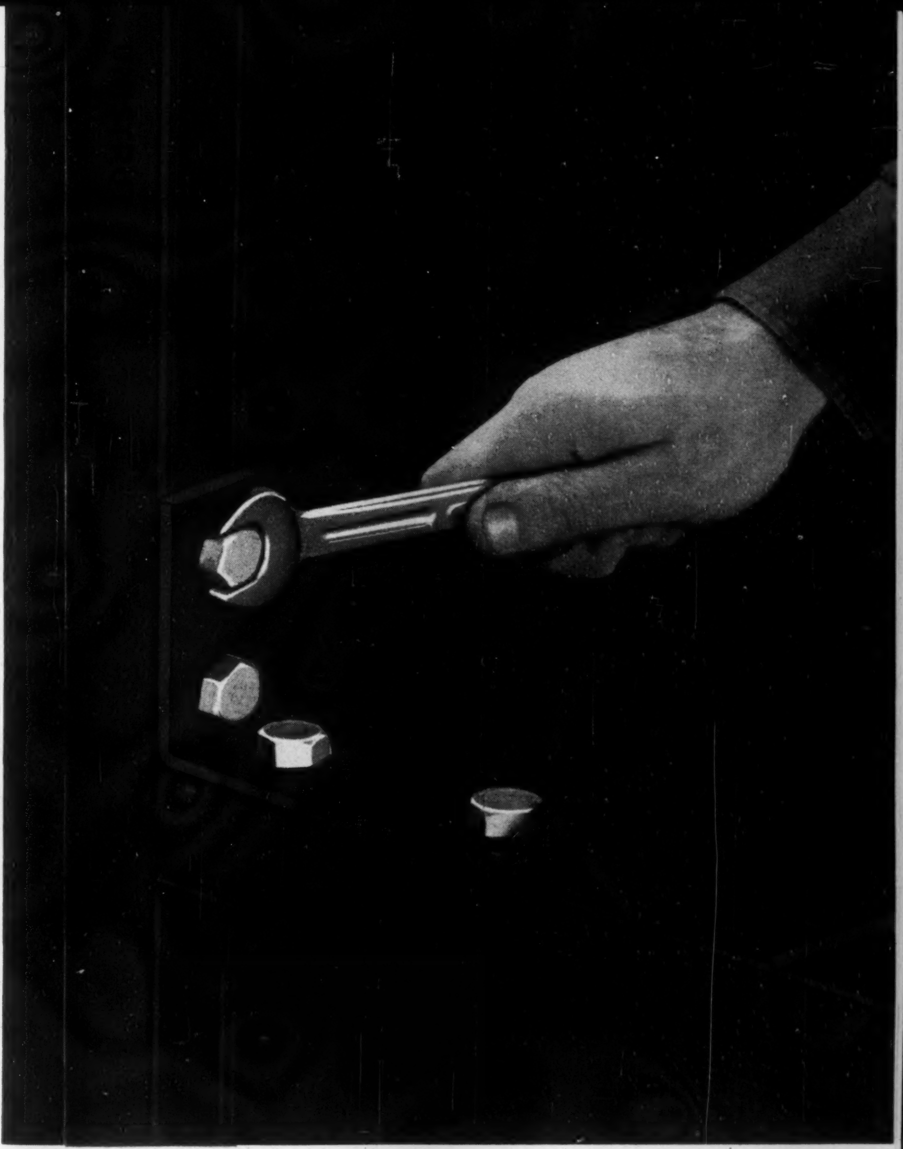
In this tunnel between two buildings, pipes of all sizes and types are supported on strong UNISTRUT framing. Exact slope and pitch are easily attained because of the adjustability of this system.



UNISTRUT framing used to rack heavy water and sludge lines at large sewage treatment plant. Note convenient UNISTRUT concrete insert on front frame.



Frames of UNISTRUT® channel mean better pipe racking for less

Note how simply UNISTRUT framing is assembled—all you do is cut the channel to length, slip in the spring-held clamping nut and tighten with a wrench. No welding, drilling or riveting is needed with this fast pipe-racking method!

To make your work even easier, UNISTRUT framing brings you a complete *package* system—everything necessary for racks to hold heavy water lines or light conduit. Clamps, concrete inserts, hangers, rollers—all these and other accessories are stock parts of the UNISTRUT system.

Getting the exact slope or pitch is only a matter of adjustment with UNISTRUT framing. And you can stop worrying about future alterations or changes. For this unique system unbolts as simply as it goes together. Permits changes or additions at any time. You can use it again and again and never lose your original investment.

Why not take advantage of this system on your next job? You'll find it reduces engineering detailing, installation time and gives you a better job for less money. Distributors and warehouse stocks available in all principal cities. In Canada, Northern Electric Company.

MR. STRUT SAYS:

See the new UNISTRUT film "The Sky's The Limit" and the UNISTRUT demonstrator car with all parts and uses of UNISTRUT framing.

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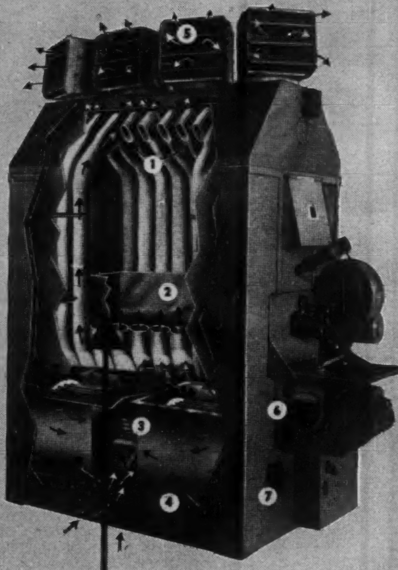
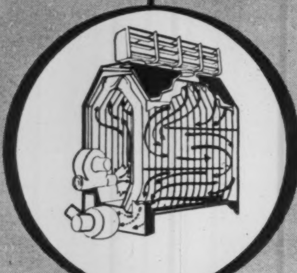
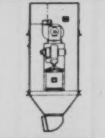
HEAT TRANSFER SURFACE

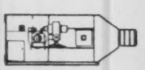




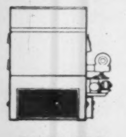
FOUR PASS GAS SYSTEM



INVERTED



HORIZONTAL



DUCT TOP

Olson Heaters are available in many models and wide variation of applications of make up air, drying, high temperature and process work. Capacities range from 300,000 to 7,500,000 B.T.U. per hour.

HEAT TRANSFER SURFACE

Induced flame and gases of combustion make four complete passes on the left and right sides of the Olson heat transfer surface, over the air to be heated. Here's a heat transfer surface even more effective than the highest recommendations of accepted heating authorities. It provides long life and maximum efficiency through the exclusive Olson feature of a bank of standard 10 gauge, 4" O.D. boiler tubes. The hot air is distributed through directional 360 louvered bonnets or duct connections.

SEPARATE DRAFT FAN

. . . . . Eliminates objectionable cold air blast at every start. Personnel directors say this extra feature is especially appreciated by employees.

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ALL POPULAR PARTS

All accessories on Olson Heaters are of the best name and quality known to heating engineers. They are standard products of nationally known manufacturers. Replacements are available anywhere.

WRITE FOR BULLETIN A1A — DETAILED, ILLUSTRATED.

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ARTHUR A. OLSON & CO., CANFIELD, OHIO
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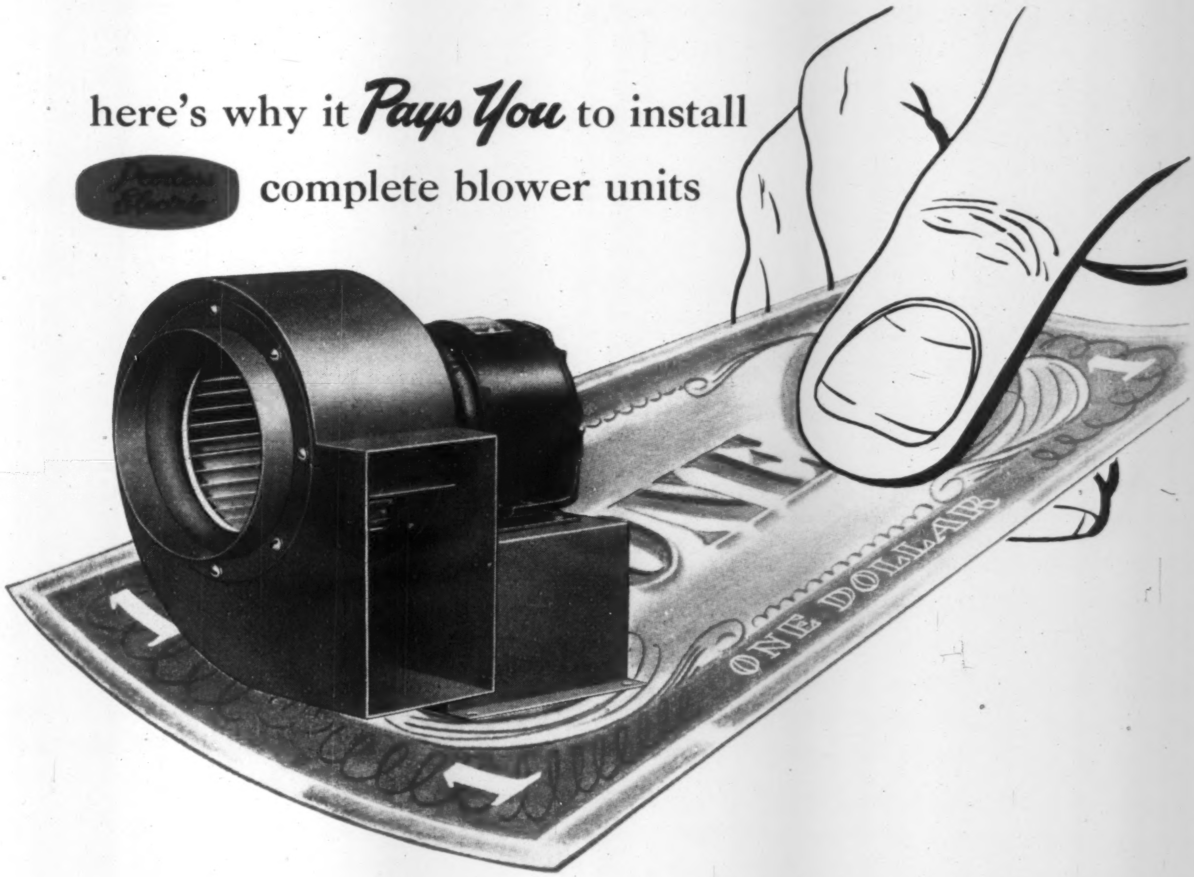
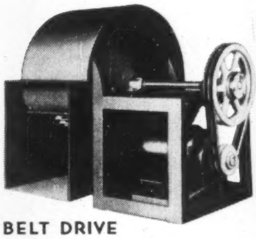
here's why it *Pays You* to install Peerless Electric complete blower units

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Peerless Blowers are easy to install, and, once in operation, they keep going without adjustments.

Profits aren't siphoned off by costly service calls when you install Peerless Fans and Blowers and, since responsibility is centered under one roof for motor, fan and frame . . . you're sure of faster service, better guarantees.

Write today for new catalog showing the complete Peerless line, available through your favorite distributor.

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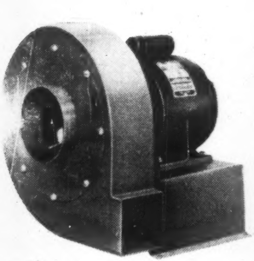
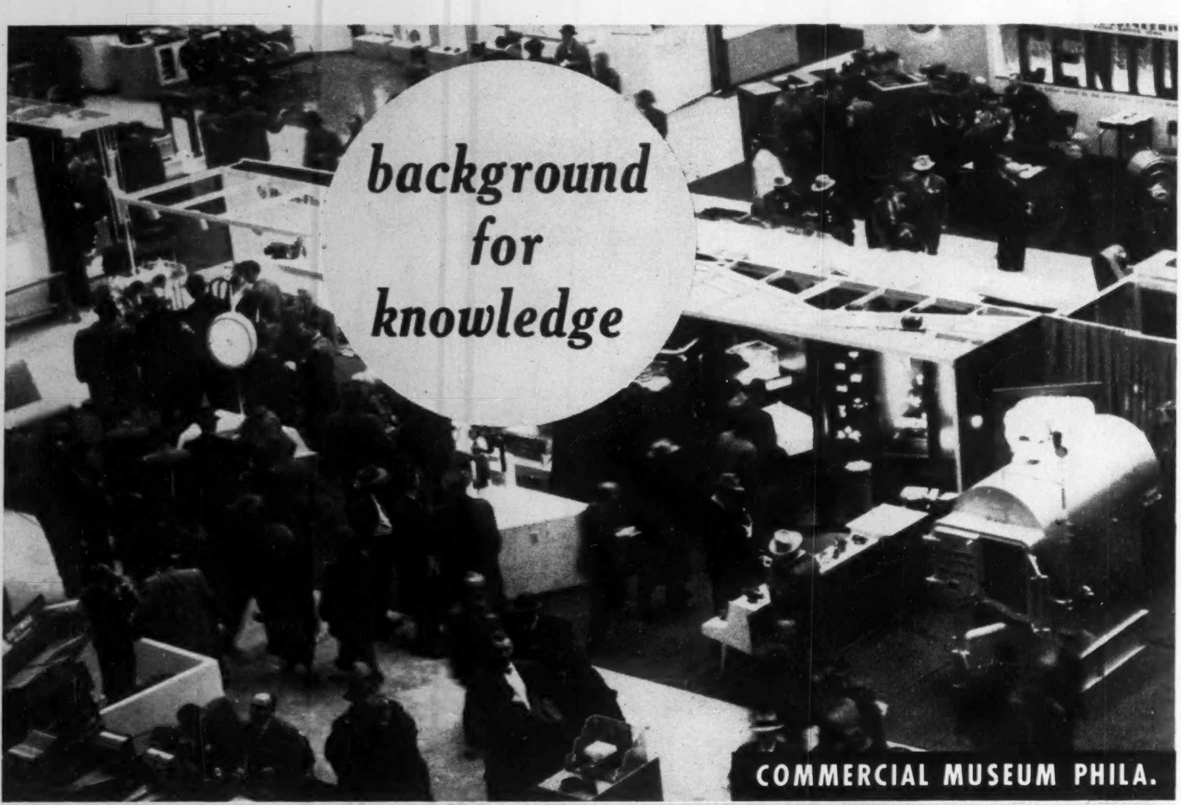

RESSURE BLOWERS

Peerless Electric



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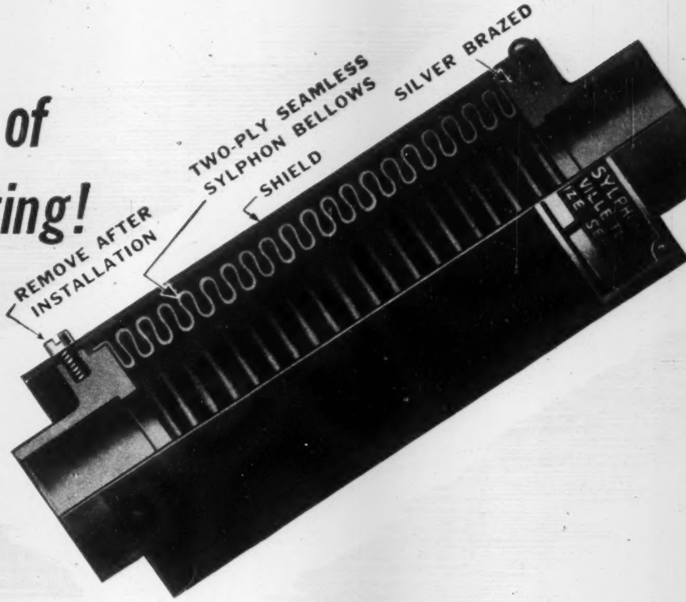
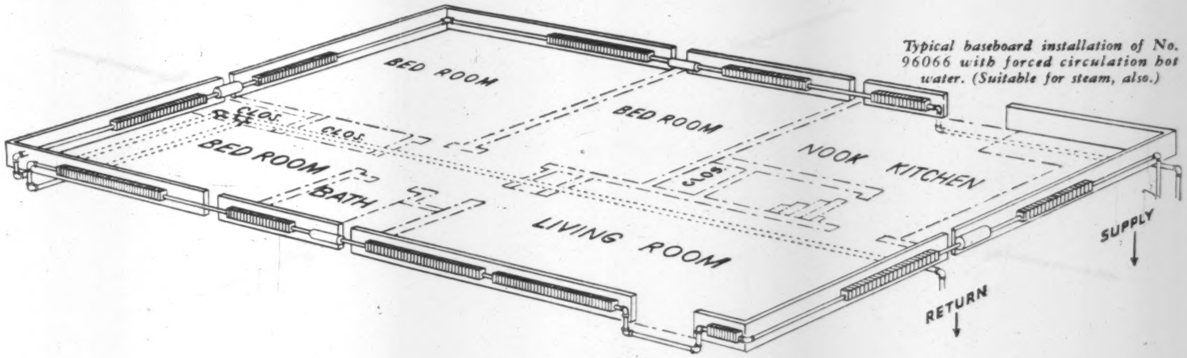
replaces packing, prevents leaks

LOW COST


REMOVE AFTER INSTALLATION
TWO-PLY SEAMLESS SYLPHON BELLOWS
SHIELD
SILVER BRAZED

New SYLPHON Packless Expansion Joint No. 96066


BED ROOM
BED ROOM
BED ROOM
CLOS.
CLOS.
BATH
NOOK
KITCHEN
LIVING ROOM
SUPPLY
RETURN

Typical baseboard installation of No. 96066 with forced circulation hot water. (Suitable for steam, also.)

THIS NEW Sylphon Packless Expansion Joint, No. 96066, provides a simple means for absorbing expansion of "baseboard" radiation, finned tube convectors, horizontal supply lines, etc. It is ideal for both hot water and steam heating lines.

Pre-assembled at the factory, Sylphon Packless Expansion Joint No. 96066 is easy to install—horizontally or vertically. It can also be removed easily from the line. Sturdily built of corrosion-resistant materials to assure long, trouble-free service. Write for bulletin that gives full details about sizes, pressure limits, etc. Ask for Catalog VH-E.

Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION • KNOXVILLE 1, TENN.

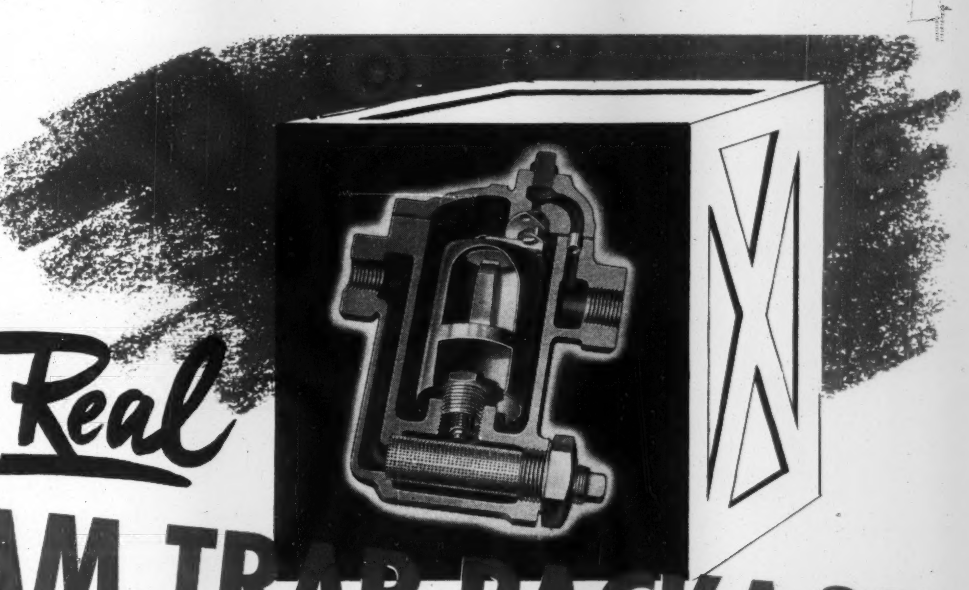
nyb FANS
HEAVY DUTY INDUSTRIAL
CLASS II and CLASS III
nyb STANDARD DUTY FANS
CLASS I and CLASS II
THE NEW YORK BLOWER COMPANY
nyb
nyb GENERAL PURPOSE FANS
THE NEW YORK BLOWER COMPANY
George:
Be sure to
send for these
new nyb bulletins
Dick.

A complete new series of centrifugal fans, both forward curve and non-overloading (IPL) offering the latest in improved design, sturdier construction and quieter operation, will be available January 1955. Bulletins describing these fans, with complete engineering data and capacity tables, are now ready for distribution.

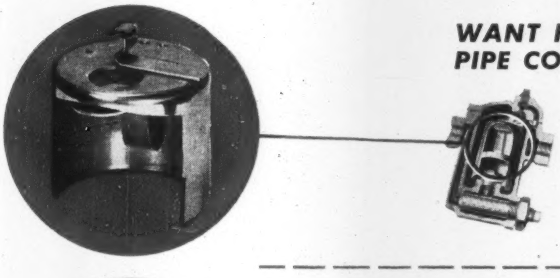
nyb

THE NEW YORK BLOWER COMPANY

SALES OFFICES • 32nd STREET and SHIELDS AVENUE • CHICAGO 16
FACTORY, LA PORTE, INDIANA

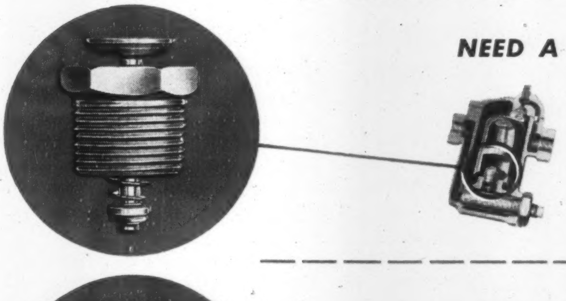


Here's a *Real* STEAM TRAP PACKAGE



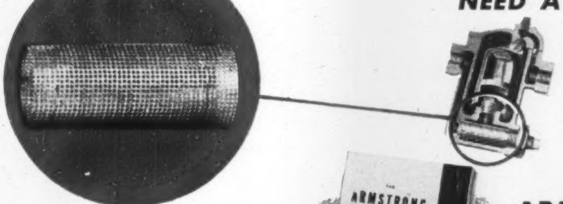
WANT FAST HEAT-UP OF OFF-AND-ON PIPE COILS, HEADERS, UNIT HEATERS, ETC.?

Speed heat-up with Armstrong thermic bucket traps. When steam is first turned on, air is pushed out the large thermic vent—fast! As soon as steam reaches the trap a thermic strip closes the vent, then the bucket functions as a regular bucket. Traps with thermic vent buckets discharge air 50 to 100 times faster than other traps.



NEED A CHECK VALVE AHEAD OF TRAP?

Just specify Armstrong with internal check valve. No check valve installation labor or fittings needed. Spring loaded action and vertical position minimize danger of dirt holding valve open. The Armstrong internal check valve is top quality—long lasting.



NEED A STRAINER AHEAD OF TRAP?

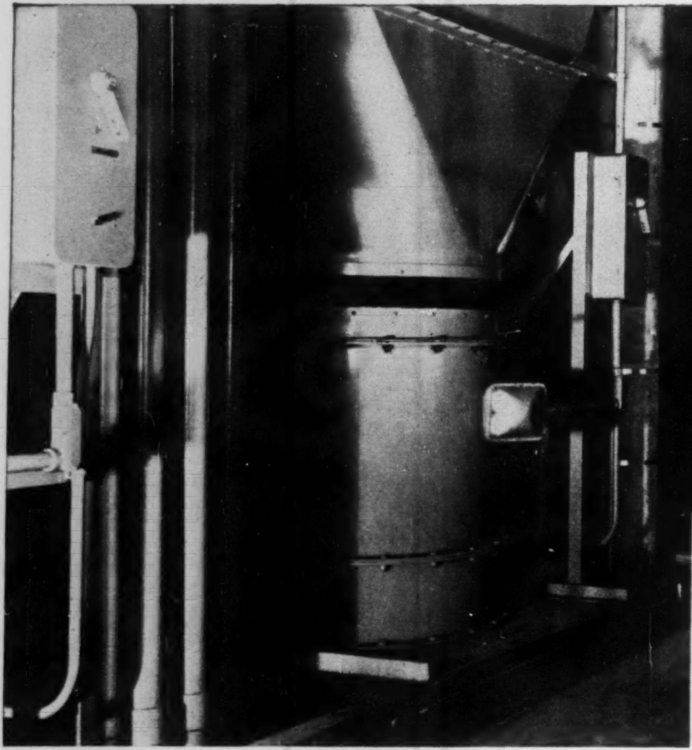
Save money with Armstrong built-in strainer traps. They cost less than a separate trap and strainer and save installation time and money. Stainless steel screen lasts a long time.

THE
ARMSTRONG
STEAM TRAP
BOOK

Get the full facts about all Armstrong traps. Send today for free Catalog J, The Armstrong Steam Trap Book.

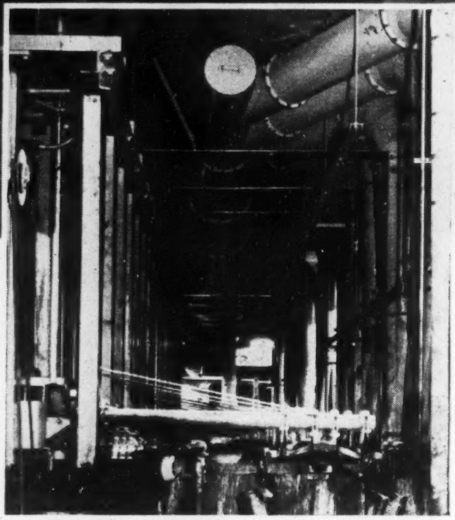
ARMSTRONG MACHINE WORKS
874 Maple Street • Three Rivers, Michigan

ARMSTRONG STEAM TRAPS



Joy fans are installed in the ducts for greater efficiency, easier installation, and economy of floor space.

PLATING LINE VENTED BY JOY AXIVANE® FANS



Vertical branch ducts draw fumes into the trunk line for ultimate discharge into the atmosphere.

Corrosive Air Removed in Jig-time By "In-the-Duct" Installation of Exhaust Fans

An interesting, and necessary, feature of the new zinc and cadmium plating line at Appleton Electric Company, Chicago, is the compactness of the Joy Axivane Fan exhaust system.

This exhaust system carries off the hot, corrosive air from the plating line up to the roof where it is discharged into the atmosphere.

Centrifugal units would have necessitated an expensive modification in the building structure, in addition to a larger, more complicated duct system.

The compact, in-line design of the Joy Axivane Fans permitted installation *right in the ducts* on the floor above the plating line. Floor space was saved, installation costs were drastically reduced, building structure did not have to be altered, and a much smaller and simpler duct system was constructed!

Joy Axivane Fans will show you new standards in efficiency, compactness, quietness, and outstanding versatility. There are 136 models . . . all with adjustable blades . . . for volumes up to 300,000 CFM and pressures to 11″ wg. Get the full story on Joy Fans by writing for Bulletin J-611, TODAY. **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer, or
WRITE FOR
THIS BOOKLET
#J-611

JOY
AXIVANE FANS

W&D I 5378

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

NOW

you can operate small valves economically & safely

with *Limitorque*® REMOTE CONTROL

NEW
LIMITORQUE
PHILADELPHIA GEAR WORKS PHILADELPHIA PA
FOR SIMPLE, POWERFUL OPERATION OF SMALLER VALVES

The new SMA-00 and SMA-000 LimiTorque Valve Control is the latest and most advanced method of operating small valves, ranging from 1½" up to 8" in diameter. These units provide complete safety to workmen, by eliminating the need of climbing to high or hazardous locations for manual valve operation. The valve operating parts are protected by two limit switches ...One provides uniform valve seating thrust, giving positive protection to the parts from overload. The second switch is the geared limit, which controls the stem travel for both directions.

SMA-00 and SMA-000 LimiTorque Valve Controls offer an extremely economical, and simple method of motorizing smaller valves. These Operators can be readily applied to all types of Valves: Gate, Globe, Plug and Butterfly . . . and may be had to actuate by a wide range of power sources including Electricity, Hydraulic Pressure, Natural Gas or Air.

For full details and information regarding these new LimiTorque Valve Controls, write for latest Bulletin.

LimiTorque Motor Operated Valves are readily adapted to Microwave Control.

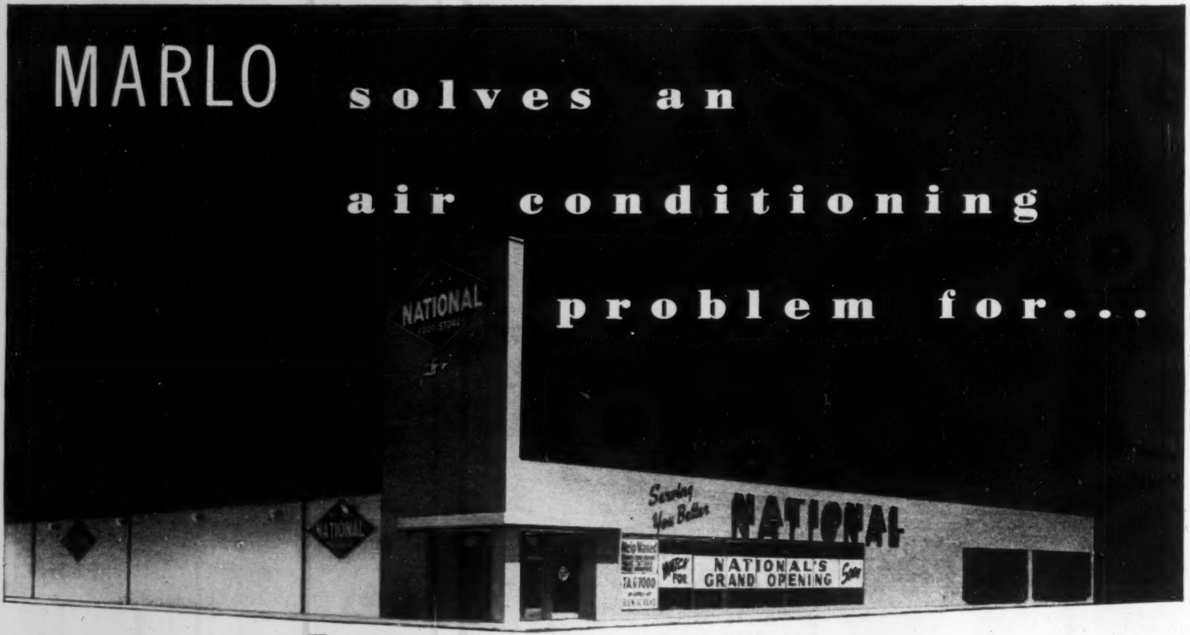
PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears & Speed Reducers

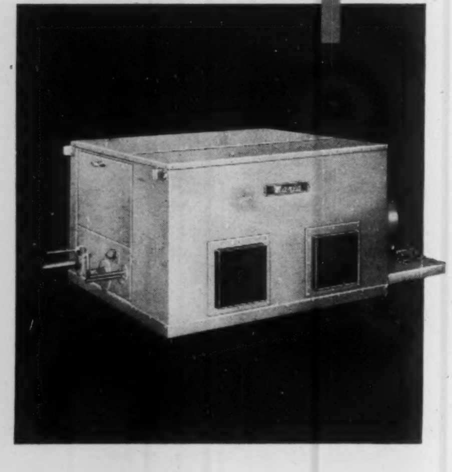
LimiTorque Valve Controls

MARLO solves an air conditioning problem for...



MARLO CEILING TYPE AIR HANDLING UNIT

For unobtrusive, out-of-the-way installation. Capacity 1.4 to 175 tons, air volume 480 to 37,000 cfm. Also available in floor type.



NATIONAL FOOD STORES

In modern supermarket operation, every square foot of space must count.

That's why Marlo's Ceiling Type Air Handling Units were such a "natural" for the newest Detroit outlet of National Food Stores. Suspended from the ceiling, these compact Marlo units release badly needed floor space for storage or other uses.

In the past year, 16 National stores in the Detroit area have been equipped with this dependable, *practical* Marlo equipment for year-round air conditioning.

If you have an air conditioning problem, you'll find the solution in the complete line of Marlo quality equipment.

Write to Marlo today for Complete Information.

Marlo
COIL COMPANY

Manufacturers of COOLING TOWERS • EVAPORATIVE CONDENSERS • INDUSTRIAL COOLERS • AIR CONDITIONING UNITS • MULTI-ZONE UNITS • BLAST HEATING & COOLING COILS

Saint Louis 10, Missouri

"...with all the trimmings"

"A good old-fashioned Thanksgiving—that's what we're going to have this year. Dinner with all the trimmings back at the farm. What are your plans?"

"Pretty much the same. It'll be good to get back with the family again. We've got a lot to be thankful for."

"We surely have. And my company will have, too, if you can meet the delivery schedules we've set up."

"We can do it. You'll have plenty of time to meet your contract deadline."

"That'll be wonderful. Wolverine has saved us a lot of time and money. Your fabrication program—along with giving us a single source for tubing—has done the trick. And that Spun End Process* you describe is a honey!"

"It sure is. And it will fit right in with some of the other products you have. One operation is all it takes to close—completely or partially—one or both ends of a length of tubing. You call the shot—we can do it. Products like accumulators, driers, and other spun-end bulbs show real savings in mechanized operations and reduced assembly time and man hours. You get a better job, too."

"We like the sound of it and we like the idea, too, that you can fabricate your tubing into so many forms."

"Yes, we fin, bend, flare, bead—just about anything that's needed. As you pointed out, we provide a single source for tubing in all three metals—copper and its alloys, aluminum, or electric-welded steel. Next time, I want to tell you about our new aluminum extruded shape facilities, too. That will be important to you."

"I want to hear more about it—but look, have a nice holiday."

"Same to you. I'll see you soon. Right now I want to whip back to the office with this order."

WE'D LIKE TO TALK TURKEY and tell you more about the cost-slashing possibilities of the Wolverine fabricated tubular parts. Our book on the subject will show you what Wolverine can do—write for it, *right now!* WOLVERINE TUBE, Division of Calumet & Hecla, Inc., 1461 Central Avenue, Detroit 9, Michigan.

*RE. 22465

WOLVERINE TUBE
DIVISION OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing
and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

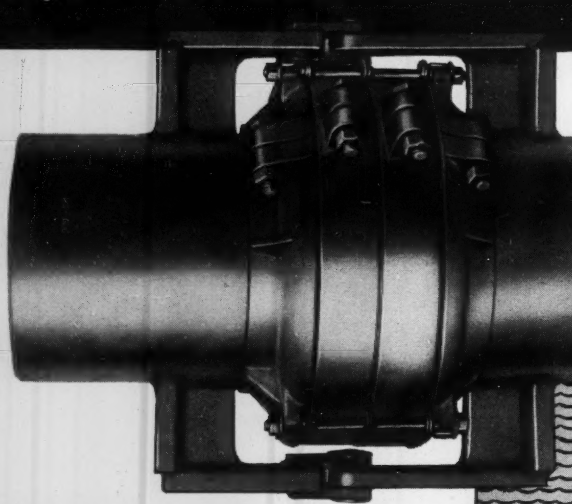
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, N. Y.

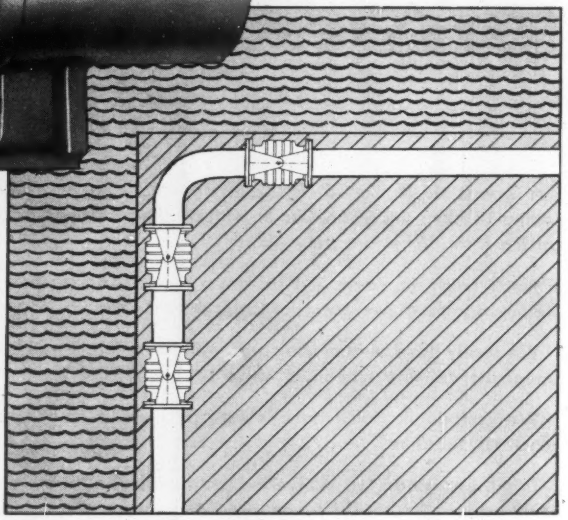
BADGER

EXPANSION JOINTS

Typifying
Joint Engineering
at its Best

THE *Hinged* EXPANSION JOINT





- **Absorbs Angular Rotation caused by Pipe Displacements**
- **Permits Line Installation without Intermediate Anchors and Guides**

The sketch shows a typical use of Badger Hinged Expansion Joints... not merely a hypothetical case but one of many instances where Hinged Joints serve as outlined above.

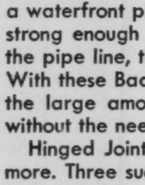
The problem was to run a steam line along two sides of a waterfront pier. However, since the pier structure was not strong enough to permit proper anchoring of the elbow in the pipe line, the standard type of joint could not be used. With these Badger Hinged Joints, it was possible to absorb the large amounts of thermal expansion in the pipe line without the need for an intermediate anchor.

Hinged Joints must always be used in groups of two or more. Three such joints give a maximum of flexibility while reducing to a minimum the thrust on the end anchors.

The Hinged Joint is but one of several special Badger Expansion Joints designed for unusual conditions. Why not outline *your* proposed pipe line installations to our engineering department? We can serve you whether special or conventional type expansion joints are needed. And back of our service is some sixty years of experience.

Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for longer traverses and higher pressure; Non-Equalizing, for shorter traverse and when pressures are low; Tandem Joints for combination axial and lateral movements; Clevis or Hinged Joints for angular rotation.

Corrugated Flexible Connectors; Flexible Pipe Line Seals for watertight connection between pipe and flood walls.



BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE 41, MASS.

It's a SNAP to Apply

BALDWIN-HILL

MONO-KOVER

ONE-PIECE PIPE INSULATION

available with Vapor Barrier Jacket

Baldwin-Hill MONO-KOVER is a flexible, featherweight pipe insulation easily applied by spreading at the seam, snapping around pipe and fastening with staples, bands or other fasteners. It is composed of incombustible, moisture-resistant mineral wool fibers, bonded with phenolic resin and molded in one-piece sections.

- Extra Light Density
- Easily Cut and Fitted
- Six Foot Lengths
- Resilient, Flexible
- Won't Break or Crumble
- Easy to Paint
- Highly Efficient
- No Coarse Fibers
- Takes Rough Handling
- Easily Nested
- Non-Corrosive
- Won't Rot, Decay, Mold
- Lower Applied Cost
- Factory Applied Vapor Barrier

Send for MONO-KOVER illustrated bulletin with complete data on how to apply, properties, efficiency, selection help, size and thickness tables.

Mono-Kover One Piece Pipe Insulation

Baldwin-Hill Company

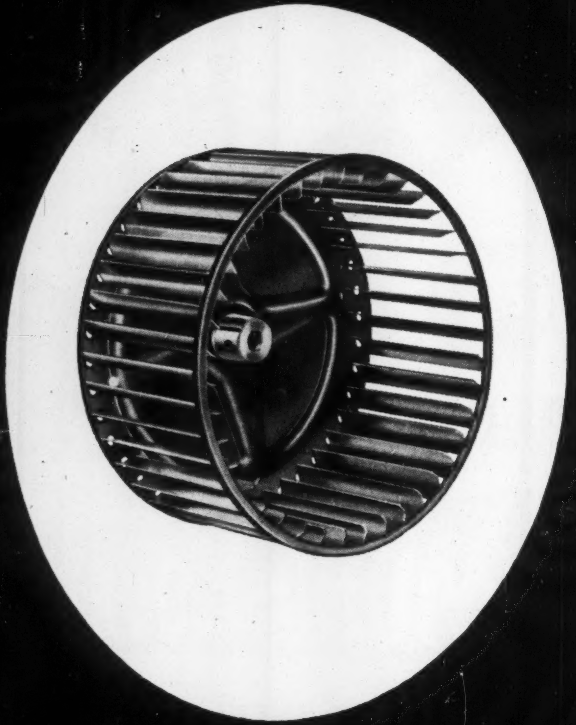
BALDWIN-HILL COMPANY

1705 BREUNIG AVE. **TRENTON 2, N. J.**

Kalamazoo, Michigan **Huntington, Indiana** **Temple, Texas**

You get MORE for LESS with

LAU *Single Inlet Wheels*



for

Oil Burners
Air Conditioners
Automotive Uses

You get efficiency plus versatility

LAU Single Inlet Wheels give you better air delivery. You get the greatest effective blade length to overall wheel length of ANY blower wheel! Each Wheel Dynagraph balanced to assure smooth, true running and extremely close tolerances. The back plate may be pied-out or solid, as desired. Available in Baked Enamel or Ruspruf (special finishes on request).

Wheel Widths 1¾″ to 4⅜″
Diameters 4¼″ to 9″
Bore Ranges ¼″ to ¾″

Also available with Guardian or Lovejoy Hubs. (Wheel widths less than 1 3/4″ available only upon special application.)

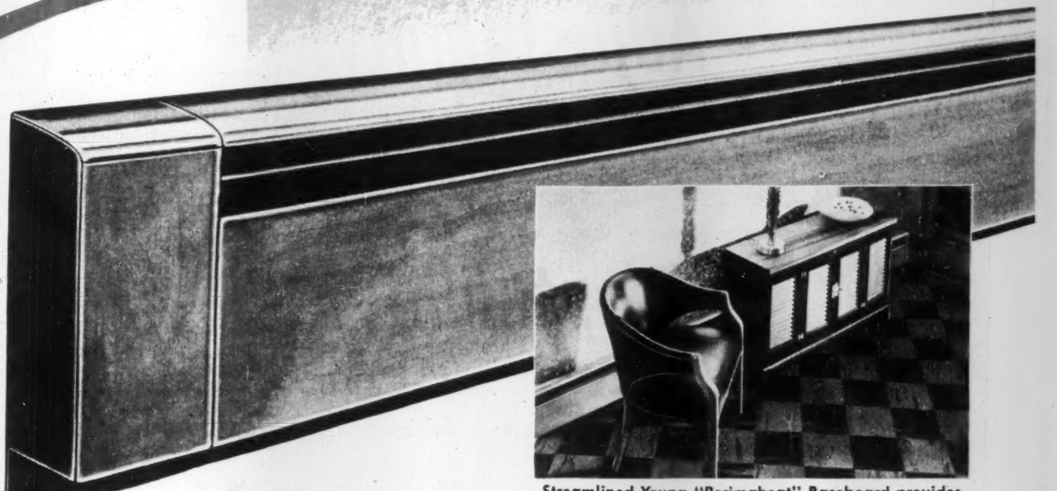
What's your problem? Lau engineering experience and know-how is at your disposal. Write for catalog 707

THE LAU BLOWER COMPANY • Dayton 7, Ohio

LAU World's Largest Manufacturers of Air Conditioning Blowers

NEW

for ARCHITECTS ENGINEERS • CONTRACTORS YOUNG "PERIMAHEAT"* Baseboard Meets Your Heating Requirements



Streamlined Young "Perimaheat" Baseboard provides floor to ceiling comfort.

Young "Perimaheat" Features Provide:

- **MAXIMUM HEATING CAPACITY**
- **QUICK, EASY INSTALLATION**
- **SLIM, MODERN CABINET STYLING**
- **MAXIMUM CLEANLINESS**
- **LOW FIRST COST**

YOUNG

Heating, Cooling, Air Conditioning Products for Home and Industry
Heat Transfer Products for Automotive, Agricultural Industrial, Gas and Diesel Engine Applications

YOUNG RADIATOR COMPANY
RACINE, WISCONSIN

Plants at: Racine, Wisconsin and Mattoon, Illinois

• Efficient Young "Perimaheat" Baseboard Convectors represent the latest in modern, space-saving heating . . . especially designed to meet architects, engineer and contractor requirements. Made to harmonize with all types of construction, "Perimaheat" is packaged in lightweight sections, and installs quickly and easily. Non-ferrous heating element provides instant heat response with draft-free convected and radiant heat combating cold at outside walls. Heated air is discharged away from walls and drapes for maximum cleanliness. Knob-controlled damper permits individual room temperature control. For complete information, write for free Young Radiator Company "Perimaheat" Catalog described below.

*Trade Mark

SEND FOR YOUR FREE "PERIMAHEAT" CATALOG TODAY

YOUNG RADIATOR COMPANY, Dept. 514-L, Racine, Wisconsin

Please send me this new catalog which describes in detail Young "Perimaheat" baseboard features, capacity, dimension and installation data.

Name____________________

Title____________________

Company____________________

Address____________________

City__________Zone_____State________

Perimaheat
YOUNG

"Sales and Engineering Representatives in All Principal Cities"

Accuracy!

Detroit's No. 411-CH *Timed Cycling* Room Thermostat assures accuracy of temperature control that ordinary thermostats can't duplicate. Uncomfortable, unhealthy over and under heating are eliminated and greater fuel savings result—a combination of true comfort and economy!

Adjustability!

Equipped with an easily adjustable parallel heater, Detroit's *Timed Cycling* Thermostat can be swiftly adapted with minimum effort to provide maximum comfort under a wide variety of installation conditions. Factory settings will take care of all average installations, yet by a turn of a screw the length of heating cycles may be changed to meet the requirements of abnormal conditions.

Adaptability!

Timed Cycling's unique parallel heater makes this remarkable thermostat suitable for *all* jobs. That's because it is not affected by variations in the electrical load. In addition, the *Timed Cycling* Thermostat saves you time and trouble by eliminating the need of selecting a special heater because it gives you *one* heater adaptable for *all* jobs!

60
70
80
80
60
70
40
50
DETROIT

that's *Timed Cycling*

by DETROIT

No. 411-CH Timed Cycling Thermostat

- Maintains constant room temperature
- Minimizes stocking and inventory
- Easy to install and service
- Good for all types of systems
- Dependable, long-life performance
- Beauty that harmonizes with the finest furnishings

Here's WHY you should demand
Timed Cycling

Get the complete *Timed Cycling* story. Find out how you can insure better heating control for your customers. Send for this free, illustrated booklet today, FORM 1545-A.

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AUTOMATIC CONTROLS *for* REFRIGERATION
AIR CONDITIONING • DOMESTIC HEATING • AVIATION • TRANSPORTATION • HOME APPLIANCES • INDUSTRIAL USES
Serving home and industry
AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

NOW!

POWER ROOF VENTILATOR
CARNES

Another Outstanding
ROOF VENTILATOR *from*

CARNES *. . . the newly designed*

MODEL CL
CENTRIFUGAL

- **LOWER SILHOUETTE**
- **WIDER CAPACITY RANGE**

This newest roof ventilator from Carnes is designed to provide a low contour for today's low parapet buildings . . . and to deliver all these fine features: Wide range of capacities; all aluminum construction; quiet operation; heavy-duty, ball-bearing protected motors; precision balanced fan wheels and efficient, trouble-free service.

CAPACITIES — 300 to 6000 C.F.M.

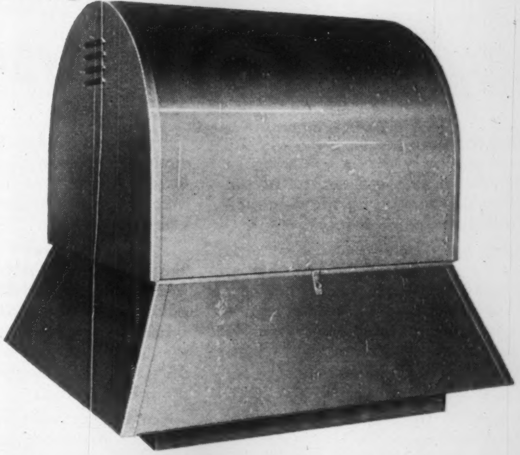
WHEEL SIZE — 5" through 24"

And... *the new* MODEL B *centrifugal*

A completely new ventilator, belt-driven for flexibility of fan speed . . . motors mounted on vibration-eliminators . . . low silhouette . . . aluminum housings are standard, with galvanized copper or stainless steel available . . . large capacity . . . hinged motor hood . . . precision-built fan wheels balanced both statically and dynamically.

CAPACITIES — 1300 to 40,000 C.F.M.

WHEEL SIZE —- 12" through 60"



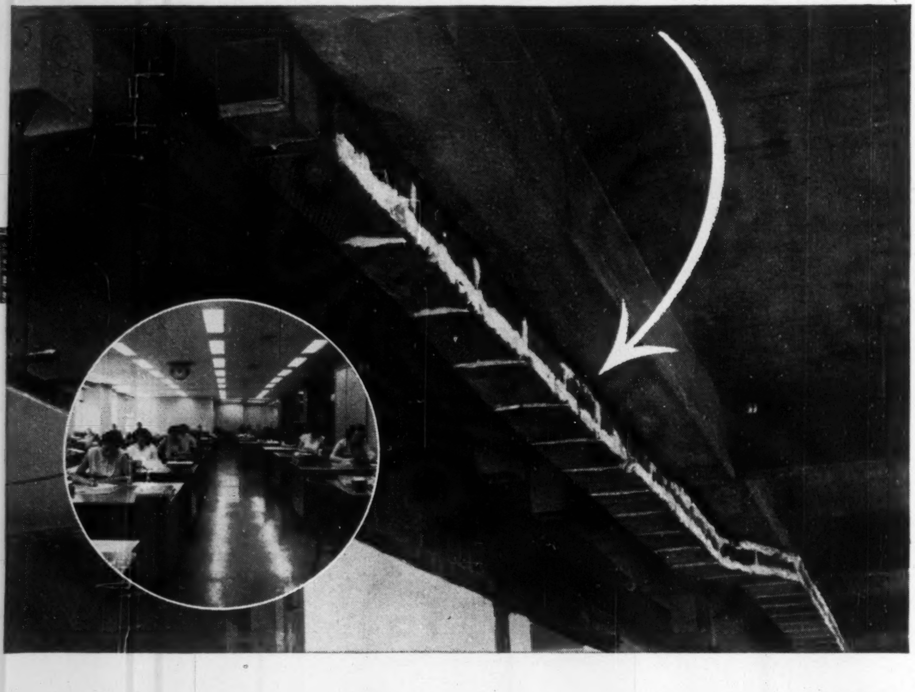
CARNES **The Most Talked About Name in Air Distribution**

CARNES CORPORATION — Verona, Wisconsin

Above: New York City's new Chrysler Building East (foreground) and the original Chrysler Building erected some 20 years ago.

Right: Spintex insulation on the air-conditioning ducts serving offices in the Chrysler Building East. Applied by the Asbestos Construction Company, Inc. of New York, an outstanding J-M Insulation Contractor.

On air-conditioning ducts serving 420,000 sq ft of office space . . .



CHRYSLER BUILDING EAST SPECIFIES J-M *Spintex* DUCT INSULATION FOR YEAR 'ROUND OFFICE COMFORT

Running through the 32 stories of the new companion structure to the original Chrysler Building are miles of air-conditioning ducts . . . all insulated with Johns-Manville Spintex.

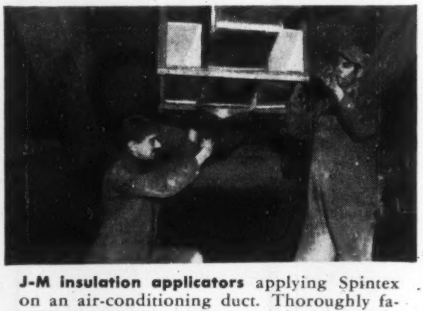
Spintex was chosen because it helps assure the greatest office comfort at the lowest operating cost. It has low thermal conductivity . . . plus resistance to moisture, fire, rot and mold growth. It is one of the most effective insulations for guarding against heat transfer and moisture accumulation.

Johns-Manville flexible, semi-rigid and rigid insulations for air-conditioning ducts meet every industrial requirement. Basically mineral products, each type has its particular characteristics that make it specially suitable for a specific air-conditioning service. All have the low heat transfer properties that are needed for high insulating efficiency.

Proper engineering and application are essential to the peak performance of any insulation. J-M Insulation Engineers and J-M Insulation Contractors stand ready to give you a top quality insulation job that will more than pay off your initial investment with maximum fuel savings.

For further information, write for a copy of Brochure IN-135A. Address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

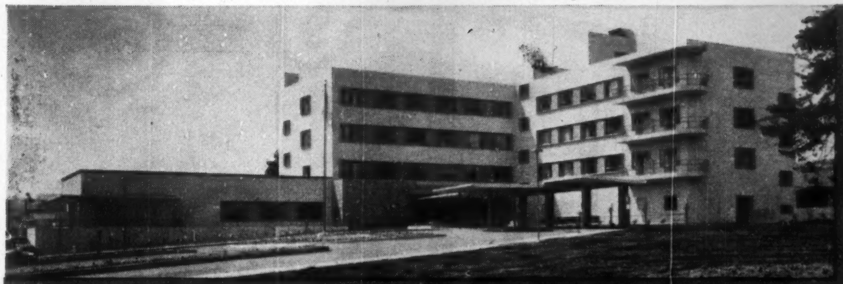
JOHNS-MANVILLE
JM
PRODUCTS



J-M insulation applicators applying Spintex on an air-conditioning duct. Thoroughly familiar with J-M insulating materials and application methods, these men have the skill that assures maximum dividends in greater fuel and power savings over the years.

Johns-Manville *FIRST IN* INSULATION

MATERIALS • ENGINEERING • APPLICATION



PENINSULA HOSPITAL
Burlingame, California

ARCHITECTS:
Stone and Mulloy
San Francisco, Calif.

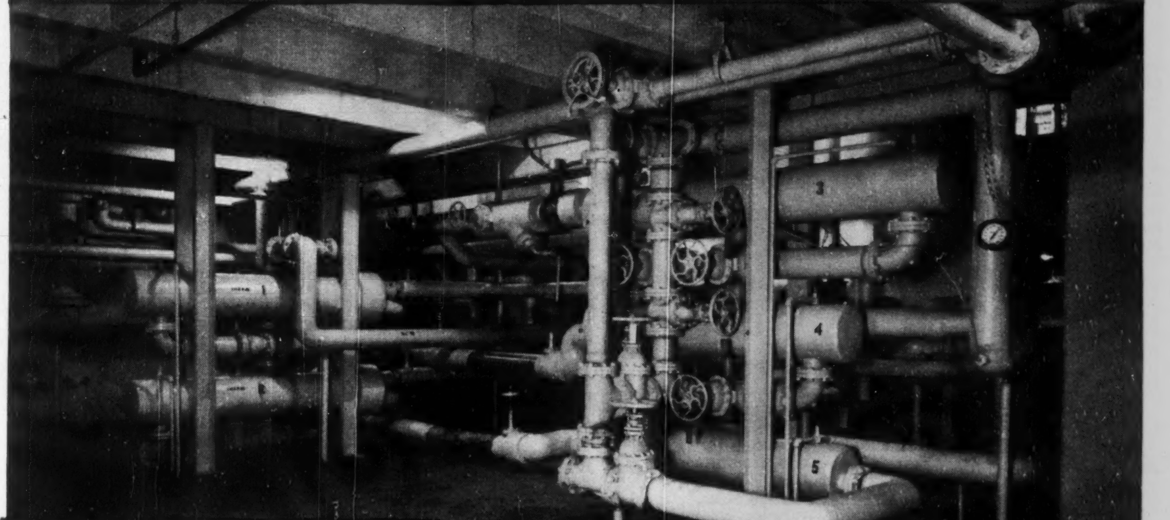
MECHANICAL ENGINEERS:
Buonaccorsi, Murray and Lewis
San Francisco, Calif.

GENERAL CONTRACTORS:
Williams and Burrows
Burlingame, Calif.

HEATING CONTRACTORS:
Harry Lee Plumbing & Heating Co.
Burlingame, Calif.

B & G *Hydro-Flo** Heating

. . . as installed in hospital, with hot water supplied by B & G Type "SU" Steam Convertors



This is an excellent example of a forced hot water space heating system in a building where steam boilers must be installed for process work.

In the Peninsula Hospital, B & G Type "SU" steam-to-water Heat Exchangers are used to supply hot water for the space heating system. The reverse return piping plan is divided into four individually controlled zones equipped with convector heating units. This method affords all the benefits of forced hot water heating without the expense of extra boilers.

Service hot water is produced in two ways. During the day it is heated by steam from the laundry boiler in an "SU" Exchanger. At night, it is heated by hot water from the space heating system circulated through "SU" Exchangers adapted for water-to-water heat transfer by removing the baffles.

Send for catalog of B & G Hydro-Flo Heating Products

B&G EQUIPMENT USED IN PENINSULA HOSPITAL

Seven "SU" Heat Exchangers • four Universal Pumps • four 1½" High Velocity Boosters • three 1¼" Boosters • two HD-3" Boosters • two PD-35 Boosters

B&G

BELL & GOSSETT
COMPANY
Dept. DQ-5, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

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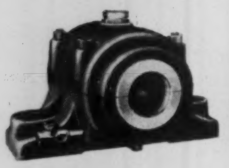
IS REQUIRED

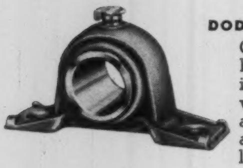
DODGE BEARINGS

FOR FAN AND BLOWER SERVICE



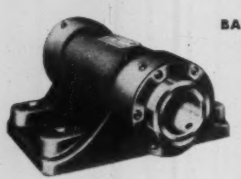
SLEEVOIL PILLOW BLOCK
A precision-built, ring-oiling babbitted bearing, self aligning and exceptionally quiet in operation.

WATER-COOLED SLEEVOIL
Sleevoil Pillow Block, designed for industrial applications where high temperatures are encountered.



DODGE BRONZOIL
Capillary bronze bushing has capacity of one-third its volume in oil. Reservoir with close fitting wick around bushing provides ample lubrication. Both pillow blocks and flange units.

BRONZE BUSHED PILLOW BLOCK
Designed for arrangement No. 2 installations. Two bronze bushings of high lead content mounted in one cast iron housing. Special T-section rings for dependable lubrication.



BALL BEARING PILLOW BLOCK
For anti-friction installations. Two single row, deep groove ball bearings in one cast iron housing. Extended inner races carry the shaft.

FOR INSTALLATIONS in hospitals, auditoriums, office buildings—wherever quiet operation is essential, Dodge offers the perfect answer to the bearing problem. Dodge manufactures a *complete line* of bearings for fan and blower service, all engineered and precision-built for exceptional quietness in operation.

The Dodge line has been developed in close cooperation with the manufacturers of fan and blower equipment, to meet the specialized requirements in this field, efficiently and economically. For complete information on Dodge fan and blower bearings see your Dodge Distributor—or write the factory.

DODGE MANUFACTURING CORPORATION
1600 UNION STREET, MISHAWAKA, INDIANA

CALL THE TRANSMISSIONEER
your local Dodge Distributor, for information about the entire Dodge line of bearings for fan and blower service. Look for his name in the Classified Telephone Directory under "Power Transmission Equipment." or write to the factory.

DODGE
of Mishawaka, Ind.

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

JUDGE
JUDGE
POWELL
JACOBS

"You see Powell Valves everywhere! And with . . .

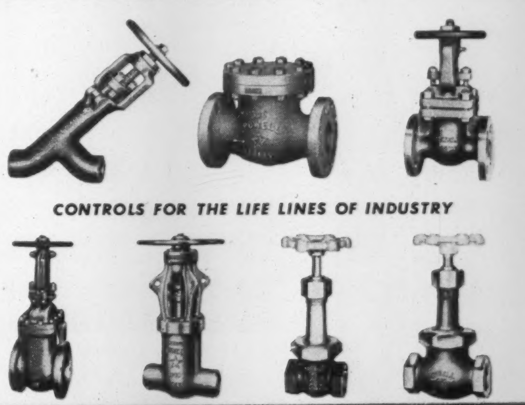
. . . good reason! They're famous for dependability. Economical, too. What's more, Powell has a complete line."

Famous for dependability

SINCE 1846

Wherever flow requires dependable control, there's *the* place for Powell Valves. Powell probably makes more kinds of valves and has solved more valve problems than any other organization in the world.

Available through distributors in principal cities. Made 1/8" to 30" and for 125 pounds to 2500 pounds W.S.P. Bronze, iron, steel and corrosion-resistant metals and alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.



Powell Valves *108th year*

40

reasons why any service requiring BRONZE GATES can be planned for lasting economy

Look over the list of 40 patterns in Jenkins' complete line of Bronze Gates. You'll find the valve you need in this new folder, with details of the *extra value* design and construction that makes Jenkins the best buy for any service. Get this folder, use it to plan your hookups for lasting valve economy.

FOR ANY SERVICE---THERE'S A JENKINS BRONZE
THAT WILL LOWER MAINTENANCE---LAST LONG

40
DIFFERENT GATES TO VALVE SATISFACTION
125 lb. — 150 lb. — 200 lb.
300 lb. — 350 lb. PATTERNS
including
SOLID WEDGE
SPLIT WEDGE
INSIDE SCREW
OUTSIDE SCREW AND YOKE
STATIONARY SPINDLE
TRAVELING SPINDLE
SCREW-IN BONNET
BOLTED BONNET
UNION BONNET
QUICK OPENING
SOLDER END
SOCKET END
plus RADIATOR, HOSE END and UNDERWRITER GATES

SOLID BRONZE OR NICKEL ALLOY WEDGE
UNION BONNET—MONEL SEAT RINGS
TRAVELING SPINDLE

SOLID WEDGE
SCREW IN BONNET
TRAVELING SPINDLE

SOLID WE
SCREW IN BO
STATIONARY S

SPLIT WEDGE
UNION BONNET
TRAVELING SPINDLE

SOLID WEDGE
UNION BONNET
TRAVELING SPINDLE

SOLID WEDGE
OUTSIDE SCREW & YOKE
RISING SPINDLE

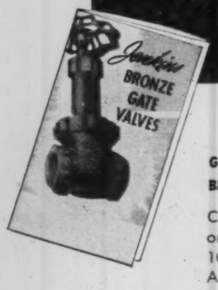
SOLID WEDGE
OUTSIDE SCREW & YOKE
RISING SPINDLE
LARGE SIZES

SELECT THE GATE YOU NEED FROM THIS COMPLETE ASSORTMENT

SWINGTITE FAST ACTION LEVER GATE

SOLID WEDGE BRONZE GATES

SPLIT WEDGE BRONZE GATES



GET THIS NEW BRONZE GATE FOLDER

Call your Jenkins Valve Distributor
or write: Jenkins Bros.,
100 Park Ave., New York 17.
Ask for Form 181-C

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros

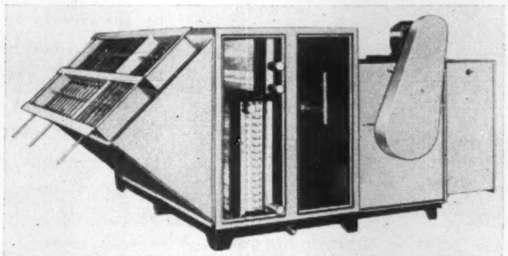
SOLD THROUGH LEADING DISTRIBUTORS

EQUIPMENT DEVELOPMENTS...

For reviews of Recent Trade Literature see Page 251.

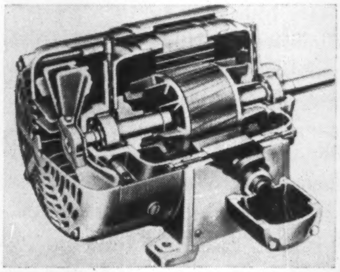
Multiple Zone Air Handling Units

For use where conditioning of separate rooms or zones of a single large room at different temperatures is required, the manufacturer has introduced a series of "Multizone Units," which make possible the individualized conditioning of such areas with a single unit. The units are available in nine sizes from 1800 to 21,600 cfm. Zone dividers can be changed in the field and discharge can be vertical, horizontal or a combination of both, states the manufacturer. Units are sectional in construction. Bush Mfg. Co., 179 South St., West Hartford 10, Conn.



Motor for Chemical Services

This totally enclosed, corrosion protected motor designed for chemical services features a stainless steel stator band surrounding the inner enclosed case, a stainless steel fan cover guard, cast iron conduit box sealed with a compound designed to be non-deteriorating and impervious, a cast iron ventilating fan for the totally enclosed design or a cast bronze fan for explosionproof service. The motor is offered in ratings from 3 to 150 hp. U. S. Electrical Motors, Inc., Box 2058, Los Angeles 54, Calif.



Heat Exchanger For Hot Water

The "Lime-Lite" integral heat exchanger is designed for use primarily on hot water supply systems where lime deposits present a problem. The supply section of the boiler is surrounded by a water jacket, which places water subject to liming in the zone of light liming conditions, the manufacturer reports.

The design integrates two systems so that the total boiler output can be drawn from either system alternately or any part of the output can be drawn simultaneously from either section, the company says.

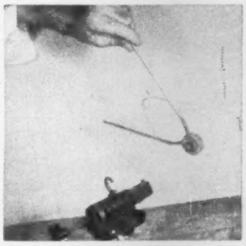
For two temperature supply systems, the secondary system is separated by baffles. Each has separate inlets and outlets. The primary heating system is designed to be used in any closed circuit such as radiant panels, convectors, coils and the like for space heating. Cited as features are removable headplates, straight through tubes and compactness. Rite Engineering & Mfg. Corp., 144 S. Mission Rd., Los Angeles 33, Calif.

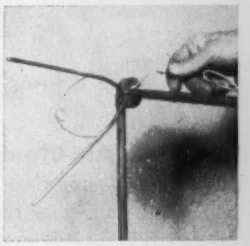
Mercury Dial Thermometer

This new mercury actuated dial thermometer features external calibration, a stainless steel case which has a plastic face covering and gasket sealed to back plate. The dial face is 3½ in. with black numerals and degree marks on white background. Dial case can be rotated to any readable position, the manufacturer states. The stem is ½ in. in diameter and has a stainless steel bulb, of standard lengths 4, 6, 8 and 12 in. Palmer Thermometers, Inc., 2505 Norwood Ave., Cincinnati 12, Ohio.

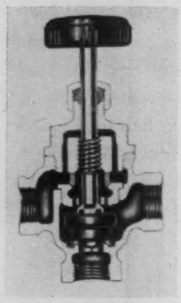
Soldering Tool

Developed for soldering "Bundyweld" steel tubing for radiant heating, this tool is preheated with a blowtorch (left) and the heat is applied indirectly in the actual soldering operation. Shown at right is the tool in application clamped onto an L fitting. Once the tool is heated, it is possible to solder six or eight joints before reheating is necessary, the manufacturer states. Advantages cited are: elimination of a fire hazard close to joists and insulation, even transfer of heat to any thin walled tubing, freedom of the workman's hands to apply flux and solder as needed, and easy inspection while the tool is in position. Beaver Tool Co., R.D. 2, Beaver, Pa.



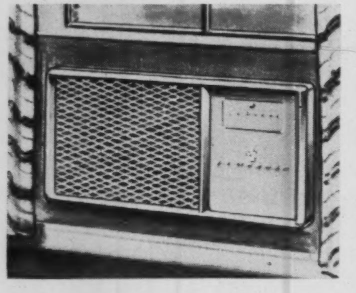


Three Way Valve



A three way valve is designed to control output of individual room units without overloading the pump. It can be used on forced circulation central heating and air conditioning systems or wherever water temperature or flow must be regulated, the manufacturer states. Total flow can either be channeled through the unit, partially bypassed in predetermined amounts, or completely bypassed. Volume of flow does not change; therefore, there is no extra load on the pump motor, according to the company. The valve body is cast in bronze alloy and has parallel, double seat construction. It has one inlet and two controllable outlet ports. The valve is available in either 3/8 or 1/2 in. pipe size and is designed to handle 300 lb of water pressure at 425 F. Ohio Brass Co., Inc., 380 N. Main St., Mansfield, Ohio.

Built-In Room Air Conditioner



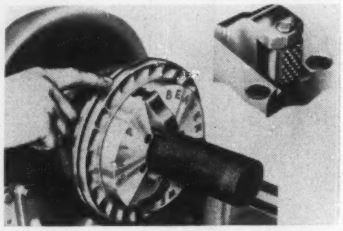
A new built-in room air conditioning unit, measuring about 18 in. by 30 in., fits into the wall like a radiator and eliminates the half opened window required for the conventional window type unit, its manufacturer states. Units will be manufactured in various capacities for apartment houses. Tywel Mfg. Corp., 60 Broadway, Brooklyn 11, N. Y.

Electronic Air Cleaners

Two new models of electronic air cleaners for large commercial and industrial installations have been announced. The larger, made to order, "Built-Up Line" is assembled and tested at the factory, match worked, disassembled and shipped to the installation site. The "Custom Line," a packaged air cleaner designed for use where space is limited, is available in sizes up to 12,600 cfm capacity at 90 percent efficiency and may be floor mounted or suspended.

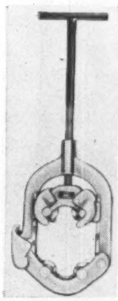
Both models operate by ionizing the particles in the entering air stream. These particles are deposited on aluminum plates and held until flushed away by water from washing manifolds. The air next passes through expanded aluminum filters which create a slight back pressure, distributing the air across the plates and preventing water from entering the duct work, says the manufacturer. Electro-Air Cleaner Co., 1285 Reedsdale St., Pittsburgh 33, Pa.

Wrenchless Power Chuck



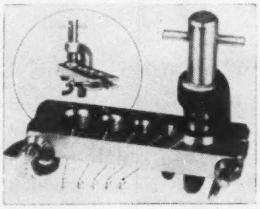
A new wrenchless power grip 1/8 to 2 in. pipe machine chuck is tightened with machine power. When power is turned on, roller grip jaws tighten themselves according to the need, remaining tight throughout the operation, says the manufacturer. The chuck is designed not to lock, slip, or crush pipe or tubing. Forward or reverse is accomplished with equal ease, speed and gripping power. Roller grip jaws are inserted without dismantling the chuck and replacement parts, if needed, can be easily installed, the manufacturer reports. Beaver Pipe Tools, Inc., 310 Dana Ave., Warren, O.

Hinged Cutter for Pipe



Offered in several sizes to cover the range from 2½ to 12 in. diameter cast iron or steel pipe, a newly designed cutter features a hinged yoke construction which calls for very little digging in ditch work and eliminates "spring" from the tool, its manufacturer states. Four razor blade wheels do the cutting and serve to reduce the amount of digging since the handle swing necessary is only slightly more than 90 deg. Wheels for steel and cast iron pipe can be interchanged. Reed Mfg. Co., 1436 W. 8th St., Erie, Pa.

New Flare Tool



This new copper water tube flare tool is designed for ¼, 3/8, ½ and ¾ in. tubing. The tubing is inserted in the aperture and tightened by a permanently attached wing nut. Flaring is done by tapping the hardened tool head and releasing. The tool is self seating and self centering, the manufacturer reports. The Schaul Mfg. Co., Cleveland 3, O.

FOR SUMMER COMFORT,

the U. S. National Bureau of Standards rates multiple layers of aluminum FIRST

among all insulations it tested, as reported in its booklet,
"Effect of Ceiling Insulation upon Summer Comfort," BMS52.
(You can get it at our expense.)

To be comfortable in summer you must ward off unwanted heat rays or radiation. Most heat flow thru a *roof space* in summer is by radiation. There is no convection down, and little conduction thru low density air.

Temperatures can reach over 140° F. in some attics. With an absorptivity for heat rays of only 3%, reflectivity 97%, and emissivity 3%, multiple accordion aluminum is an effective shield against summer heat. The slight mass of its components, air being preponderant, makes it very low in heat storage.

COST OF AIR-CONDITIONING REDUCED

This shield against radiant heat lifts part of the load from house-cooling equipment, reducing installation and up-keep costs. But the building, which is *not* artificially cooled, needs this shield even more!

Multiple accordion aluminum is also markedly effective against radiation through a *wall space.*

Air of higher outside temperatures will support more vapor than the cooler air inside a building. Often vapor flows from the outside to the inside of the house, obedient to the law of physics that vapor travels from areas of greater to less density.

Multiple aluminum has long, continuous metallic sheets on *both* sides which are almost impervious to water vapor. Infiltration under the flat, stapled flanges is slight. The scientific construction of multiple layers of aluminum, fiber and air spaces, minimizes condensation formation on or within this type of insulation. Timber rot, crumbling plaster, peeling paint, etc. are minimized.

CAUTION: *We do not recommend that vapor barriers be placed on both sides of all insulations.*

IN WINTER, NEED FOR INFRA EVEN GREATER

The low conductivity, the slight heat ray absorptivity and emissivity of multiple accordion aluminum, and the retarding of inner and outer convection by the multiple layers of metal and fiber, amazingly effective in summer, assume paramount importance in winter when this 3-fold bar to outward heat flow cuts fuel bills and increases comfort.

To obtain MAXIMUM, **uniform-depth** protection against heat loss and condensation formation, it is necessary to use the new **edge-to-edge** multiple aluminum*, **each** sheet of which stretches from joist to joist, and also all through the flanges for further vapor protection as well as permanent attachment of each sheet.

*Patent applied for.

U. S. DEPARTMENT OF COMMERCE

BUILDING
MATERIALS
AND
STRUCTURES

REPORT BMS52

Effect of Ceiling Insulation
Upon Summer Comfort

by
THOMAS D. PHILLIPS

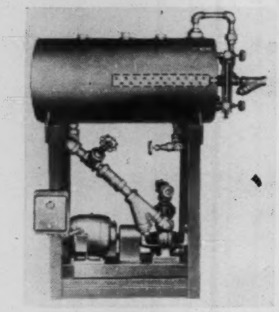
COST OF EDGE-TO-EDGE INFRA
Multiple Aluminum Insulation
installed in new construction between
wood joists, material and labor
Type 6-S under 9½¢ sq ft.
Type 4-S under 7½¢ sq ft.

INFRA INSULATION, INC.
525 Broadway, N. Y. C. Dept. H-11
☐ Send Bureau of Standards Booklet BMS52. ☐ Send Infra samples.
Name________________
Firm________________
Address________________

INFRA INSULATION, INC., 525 Bway., New York, N. Y.

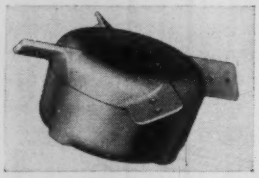
Preheater for Boiler Feed Systems

A preheater that operates on steam from the boiler and automatically maintains boiler feedwater between 190 and 200 F, has been incorporated in a new boiler feed system to lengthen boiler life, its manufacturer states. The systems, having tank sizes from 30 to 540 gal, are designed to supply from 280 to 2800 gal per hr of preheated water. A perforated tube inserted horizontally into the feedwater tank is connected to the steam supply. The unit is thermostatically controlled so that steam is allowed to enter the unit only when the temperature falls below a predetermined point. A thermostatic bulb filled with a pressure sensitive fluid controls a flexible bellows that mechanically opens and closes the valve. Cyclotherm Div., U. S. Radiator Corp., 157 E. First St., Oswego, N. Y.



Direct Drive Fan Motors

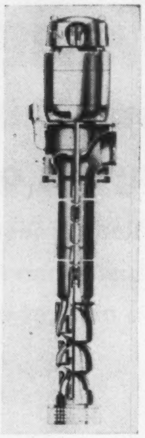
A new series of three direct drive fan motors have the following design advantages listed by the manufacturer: single point mounting with "floating action" which minimizes transmission of noise and vibration and which simplifies assembly of the motors into ventilation equipment and a cast aluminum, rotating end bell which features integral cast flanges tapped for quick screw mounting of individual aluminum blades. The units are designed for use in home, commercial and light industrial ventilation equipment. Electric Motors & Specialties, Inc., King and Hamsher Sts., Garrett, Ind.



New pH Instrumentation Systems

Complete systems for pH recording and control, which incorporate the new "Beckman Model W" amplifier, have been announced. These systems include an electronic "dynamaster potentiometer" recorder or controller, the amplifier, electrode assemblies in either flow or immersion types, and a variety of final control elements for the addition of gaseous, liquid, solid, or slurried reagents, their manufacturer states. The Bristol Co., P. O. Box 1790, Waterbury 20, Conn.

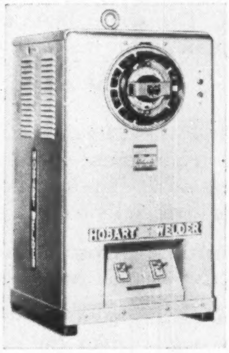
Vertical Centrifugal Pump



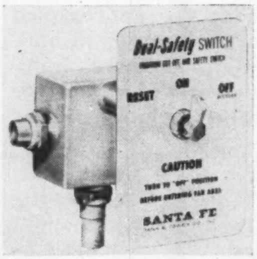
The "Sumpmaster" is a standardized single or multistage vertical centrifugal pump operated at a moderate speed especially for pumping from sumps, its manufacturer states. It is constructed of components and materials, designed and tested for its wide range of applications, says the company. That it is self priming, available in either oil or water lubricated models, and suitable for outdoor installation without protective enclosure are cited as features. Available in four column lengths, 5, 10, 15 and 20 ft, the models have capacities to 2600 gpm, heads to 300 ft and are furnished with vertical hollow shaft motors, 3 phase, 60 cycle, 220 or 440 volt, the company says. Byron Jackson Co., Box 2017, Terminal Annex, Los Angeles 54, Calif.

A-C Type Welder

A new a-c welder, the manufacturer's model "SLP", is available in 300, 400 and 500 amp sizes for a wide range of production jobs. The transformer is of the shell type design, using "saturable leakage path" control for adjustment of welding current. An extra secondary winding supplies current to the control rectifier. The manufacturer states that the control is sensitive to a wide range of welding conditions and highly responsive to changing arc conditions. Hobart Brothers Co., Hobart Square, Troy, Ohio.

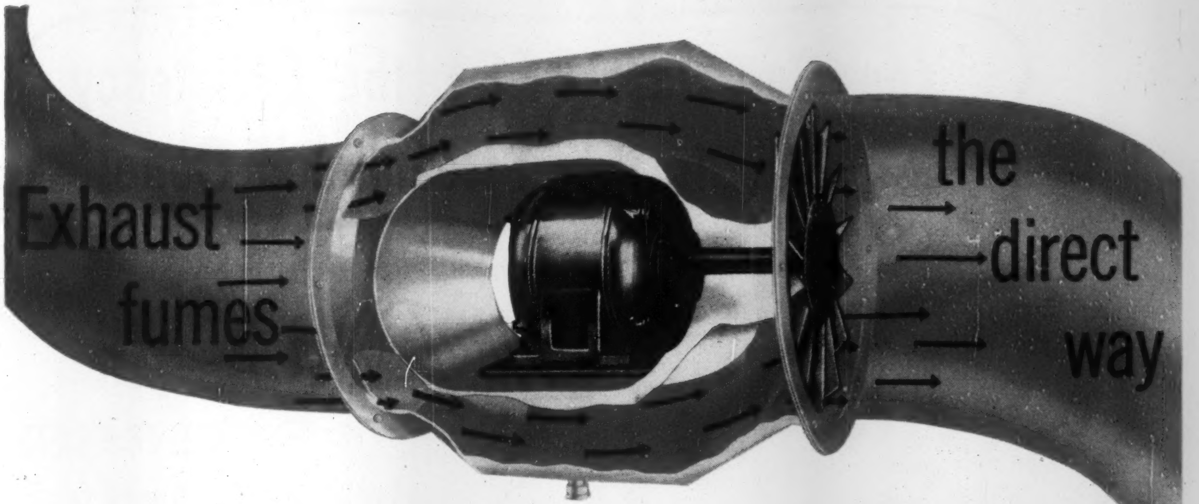


Safety Switch for Cooling Tower Fans



"Dual-Safety Switch" combination vibration cutoff and safety switch for cooling tower fans. A mercury switch automatically stops the fan motor when vibration indicates trouble. Sensitivity is set by a manual adjustment. The control is operated from the cooling tower deck without the fan stack being entered. Santa Fe Tank & Tower Co., Inc., 5401 S. Boyle Ave., Los Angeles 58.

(*Continued on page 236*)



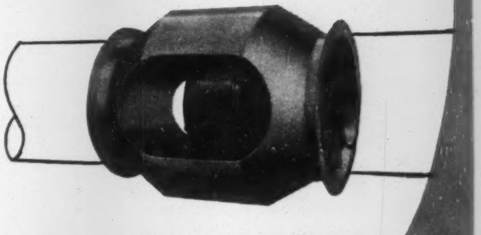
BIFURCATOR FAN EFFICIENTLY EXHAUSTS HOT, CORROSIVE, FLAMMABLE AND EXPLOSIVE FUMES

Bifurcator Fans exhaust fumes at *top efficiency* by avoiding a directional change in the air stream. Other fans often require a 90° change in direction of the exhaust stream with resultant loss in efficiency.

The fan motor stays clean, cool and accessible. Fumes are by-passed (bifurcated) around the motor chamber which is completely isolated from the exhaust stream.

A Bifurcator Fan is easily installed . . . just like a flanged section of ductwork. It can be mounted horizontally, vertically or at an angle. Lightweight and extremely compact, a Bifurcator requires no platform or supports. Bifurcators are available in sizes from 1140 CFM (12″ diameter fan with 1/20 HP motor) up to 45,000 CFM (48″ diameter fan with 20 HP motor). Housings and fan wheels can be fabricated of non-corrosive metals, or can be protected with a variety of corrosion-resistant coatings.

Be ready with the facts about Bifurcators next time you have a fume removal problem. Fill in and mail the handy coupon below . . . TODAY!



Bifurcator Fan installs just like a section of ductwork.

a summary of
design data for
exhaust systems
BIFURCATORS

"DESIGN DATA FOR EXHAUST SYSTEMS"
This helpful bulletin contains details, simplified data and charts. Compiled by Allen D. Brandt, Senior Sanitary Engineer, U. S. Public Health Service. Mail coupon for your FREE copy and Bifurcator Bulletin.

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"You Can Just FEEL the Efficiency in this Streamlined Cone!"

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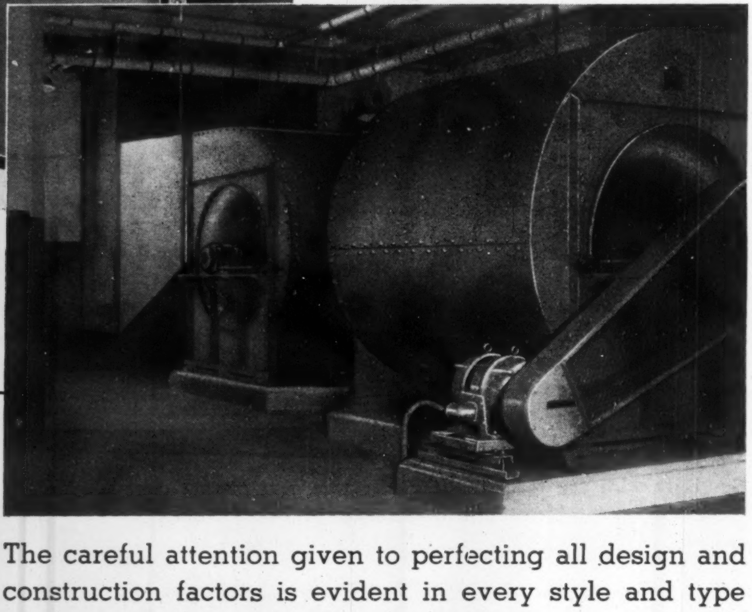
From Drawing Board to Finished Equipment, For Smooth, Quiet Fan Operation . . .



Two No. 445
Type AP-DWDI
Supply Fans
In Gen. Acctg.
Office Bldg.,
Washington, D. C.

Your inquiries will be given the promptest, most thorough attention by our engineering staff. Illustrated literature upon request.

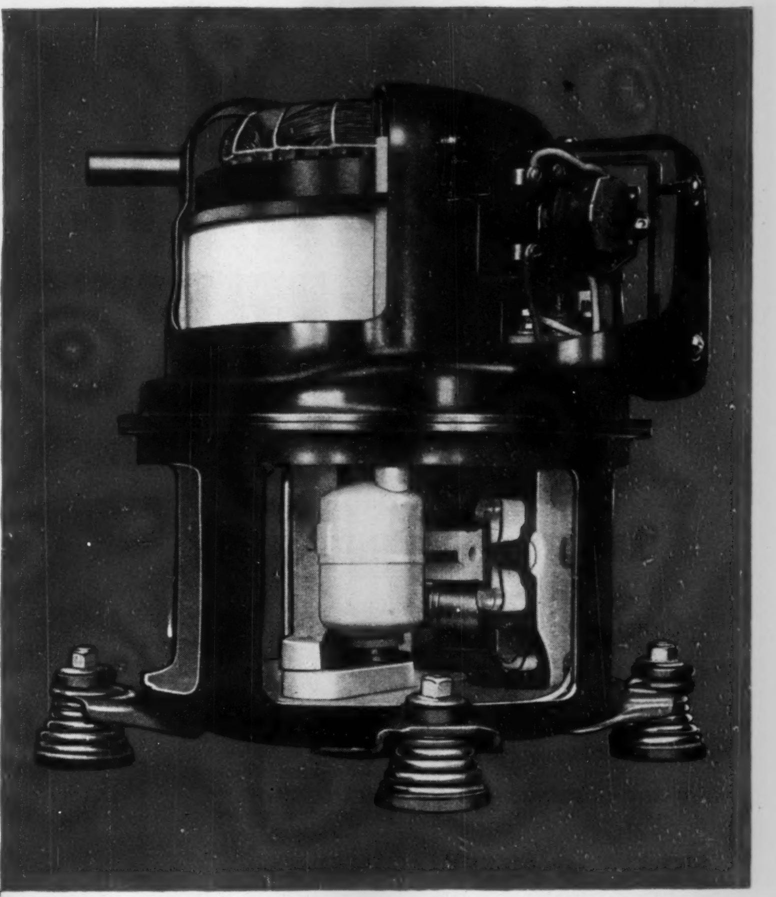
The careful attention given to perfecting all design and construction factors is evident in every style and type of fan or blower in the complete BAYLEY line . . . Result — a consistently high standard of performance and dependable, trouble-free service. This is why foremost system designers, contractors, architects, and owners feel confident in specifying BAYLEY for every class of air-handling requirement.

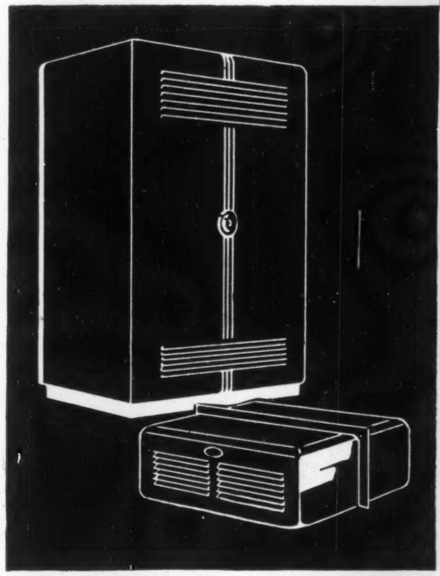
BAYLEY BLOWER COMPANY

6600 W. BURNHAM ST. MILWAUKEE 14, WIS., U. S. A.

COPELAND WELDED HERMETICS

bring cool-running, 2-cylinder smoothness to package air conditioning





You're looking at a cutaway view of the welded motor-compressor that can give your refrigeration and air conditioning products the competitive edge you need.

This potent Copeland package is engineering at its best. Twin cylinders bring whisper-quiet smoothness. Heavy-duty, high power factor motor insures positive performance and long-range economy. Use of F-12 in these motor-compressors can result in as much as 75 F. lower temperatures in windings, crankcase, oil and discharge side. You'll appreciate their high capacities.

We could go on, point by point, and prove construction superiority. Better yet, we want you to test the Copeland welded motor-compressor in your own equipment under your own conditions.

Write, wire or phone for details about the "try it yourself" test.

REFRIGERATION UNITS (OPEN-TYPE AND COPELAMETIC)

Copeland

DEPENDABLE *Electric* REFRIGERATION

WATER COOLERS

COPELAND REFRIGERATION CORPORATION SIDNEY, OHIO

The NEW 3 R's for

CONTINENTAL

AIR FILTER USERS

1. Rinse
2. Re-use
3. Repeat

NEW SYNTHETIC MEDIA AROUSES TRADE'S INTEREST

Quick and widespread response to recent introduction of Continental's *new* and *different* DYCON DY filter indicates it fills a long-standing need for a service-easy, clean filter.

NO OIL or MESSY ADHESIVES with DYCON DY!

DYCON DY pricing offers you an advantageous discount. Cut yourself in on this profit-maker. Order your stock today — or write for Bulletin 550 which tells how and why DYCON DY 1-inch filters are a better buy.

with

DYCON

TYPE DY 1-INCH

DRY AIR FILTERS

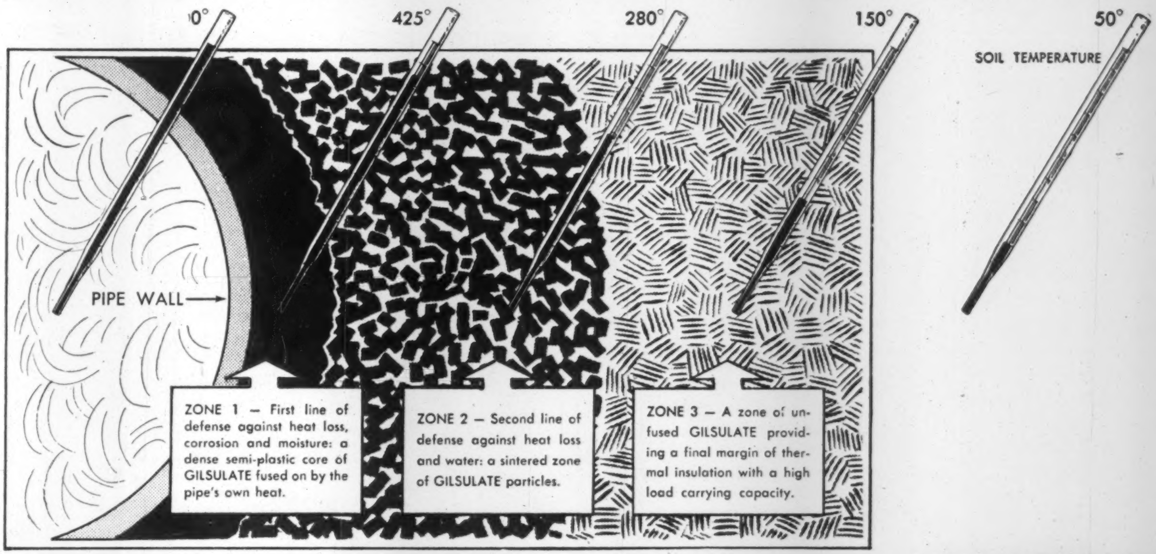
AIR CONTINENTAL FILTERS

P. O. BOX 1647 LOUISVILLE 1, KY.

CONTINENTAL AIR FILTERS Inc.

Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY HOT UNDERGROUND PIPE INSULATION



ZONE 1 — First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.

ZONE 2 — Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.

ZONE 3 — A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

GILSULATE®... the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520°F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot *than any other underground pipe insulation*... it's easiest to use... and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- *3 grades available*—220° to 520°F
- *needs no sleeves* or mechanical sheaths
- *requires no mixing* or special handling
- *can't be punctured*—leave rocks in backfill
- *pipe expands and contracts* within Gilsulate structure
- *proved in actual use* in hundreds of new construction and replacement installations

Send coupon for descriptive literature.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES.

American Gilsonite Company
134 West Broadway, Salt Lake City 1, Utah
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

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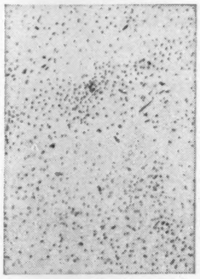
Random Thoughts from a Filter Engineer

by Frank Purvis

- **WORLD'S MOST EFFICIENT FILTER PANEL WON'T ALWAYS CATCH THIS DIRT**
- **THE PRICE OF A PUSH-BUTTON AGE**
- **MORE PROTECTION FOR FILTER PANELS**

WORLD'S MOST EFFICIENT FILTER PANEL WON'T ALWAYS CATCH THIS DIRT



We hear a lot of talk about filter efficiency these days and we think it's a good thing. But it seems odd to pay so much attention to the efficiency of the filter and then lose all you've gained and more by not installing the filter properly.

No filter is any better than its seal. If dirty air escapes around the perimeter of the filter panel, you're not getting the efficiency the manufacturer built into the filter. The same may be said for a filter panel that doesn't set square in its frame, or one that has faulty holding devices. All the air is not passing through the filter media so all the dirt can't be removed.

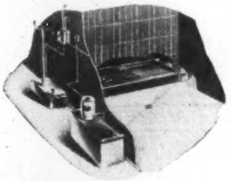
It's a little like being very careful to lock the front door while the back door stands wide open. It nullifies the extra filter efficiency manufacturers have built into a filter.

This may seem a bit obvious and, actually, it is. But it's a common mistake and one which can be costly. So we pass it along for what it's worth.

THE PRICE OF A PUSH-BUTTON AGE

The trend is to automatic. That's part of our push-button age. The more automatic an operation is, the prouder we are. But push-button operation is a mixed blessing. Is it better to do more by hand and pay less for controls? Or pay more for controls and save man-hours?

A buyer has to answer this one for himself. But so far as cleaning and oiling our Electromaze electronic air cleaner goes, the buyer has a wide choice. We offer manual cleaning and oiling at lowest cost; a semi-automatic service system for those who want to pay a little more and do a little less; and an automatic service system for those who want a complete push-button operation.



Cutaway view of typical Electromaze assembly with semi-automatic service system.

We think the semi-automatic service system strikes a nice compromise and may be just the ticket for many of our customers. A turn of a crank propels a series of jets back and forth underneath the Electromaze. Vertical streams of water clean the filter, then vertical streams of oil renew the adhesive. Where it might take a man a full day to clean the average installation manually, he can do it in about ten minutes with the semi-automatic system.

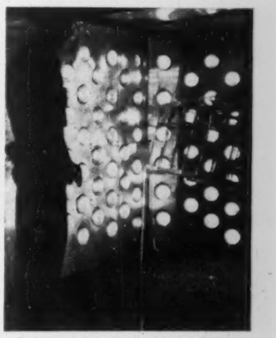
And it's easy as A, B, C to operate. After turning off ventilating blower and Electromaze, turn on the washer water. Slowly turn the washer crank until the spray unit has made about fifteen passes in each direction. After the washing cycle is completed, and the Electromaze cells are dry, turn on the oil pump. Then turn the crank as before and drive the spray unit to the opposite end and back, making one pass in each direction. Switch off the oil pump and that's all there is to it.

MORE PROTECTION FOR FILTER PANELS

Most everyone knows filter panels lead a rugged life. Some of them have to live with corrosives. Some with high temperatures. And often they're banged around quite a bit. Any of these things can cause the paint to chip or peel.

We try to avoid this by protecting our Air-Maze filter panels with a new synthetic coating that gives more protection than ordinary enamels or paint. It costs us a little more but, because it's more durable, we think it's worth it.

We hope nobody ever wants to remove this coating from one of our filter panels because it's hard to take off even in a stripping tank.



Infrared lamps drying paint on section of filter framework.

This special coating is just one of many little "extras" we build into our filter panels and holding frames. Separately, they're not of vital importance. Together, we think they make a big difference. The Air-Maze Corporation, 25000 Miles Avenue, Cleveland 28, Ohio.

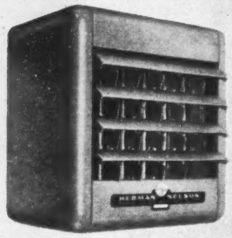
AIR-MAZE

The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS
LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

Some like it wet

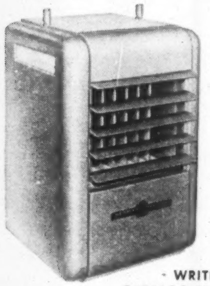
Recommend for them the Herman Nelson Horizontal Unit Heater, designed for either steam or hot water service. Made in 19 sizes . . . a complete range for every job. New Vertical Fin Assembly, working with horizontal louvers, spots or diffuses heat *anywhere* or *anyhow* you want it!



WRITE FOR CATALOG No. 700

Some like it dry

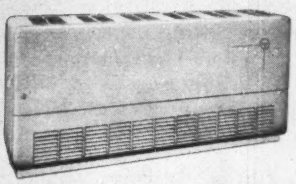
For them, install the Herman Nelson Gas-Fired Unit Heater, available in 7 sizes—job-rated for stores, lobbies, studios, warehouses, offices, salesrooms—wherever *both* beauty and efficient heating are your requirements.



WRITE FOR
CATALOG No. 715

Some like it on the floor

Offer those customers the handsome new Console Heater that solves heating problems in a wink . . . works quietly and efficiently year after year, utilizing steam or hot water. Twelve models in all—not only for floor installation, but also for wall, ceiling or recessed applications.

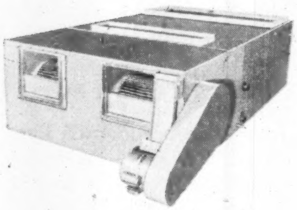


WRITE FOR CATALOG No. 725

Some like it high

This new Heating and Ventilating Unit may be hung from ceiling out of the way, or mounted on wall or floor. A quiet-operating, slow speed unit with completely rotatable fan section. Sectional type unit may be assembled many ways for all types of institutional and commercial installations.

Write for free descriptive literature . . . today!



WRITE FOR CATALOG No. 775

PLEASE 'EM ALL WITH JOB-RATED

HERMAN NELSON UNIT HEATERS

Choose From A Complete Range Of Models And Sizes

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COMPANY, INC.

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...now with your choice of burners from 3 leading manufacturers!

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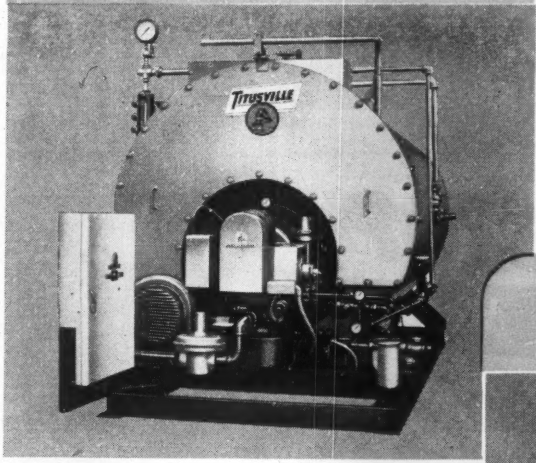

Three complete boiler-burner packages—each in a full range of sizes—each with its own leading make of burner, handling oil, gas, or combination oil and gas—each with the TITUSVILLE boiler that assures maximum efficiency and dependability on the job! Whether your needs are for power or heat, whether you require one or a battery of modern package units, you'll find in *Titusville-Iron Fireman, Titusville-Petro* or *Titusville-Ray* the exact boiler-burner you should have. Write for descriptive Bulletins, today!

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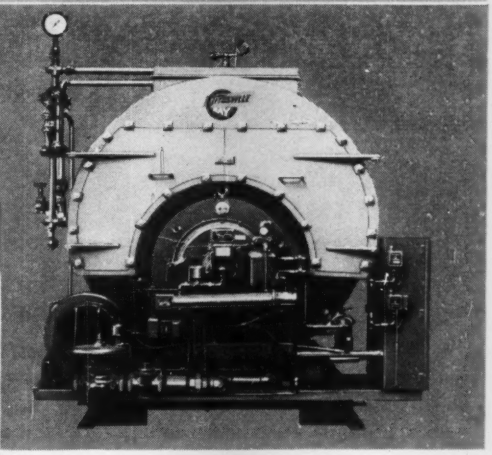
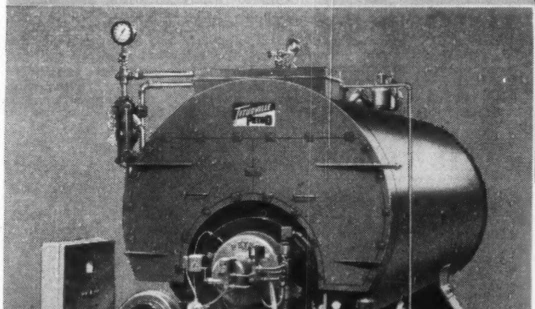


TITUSVILLE-
PETRO



The Titusville Iron Works Company

Division of Struthers Wells Corporation
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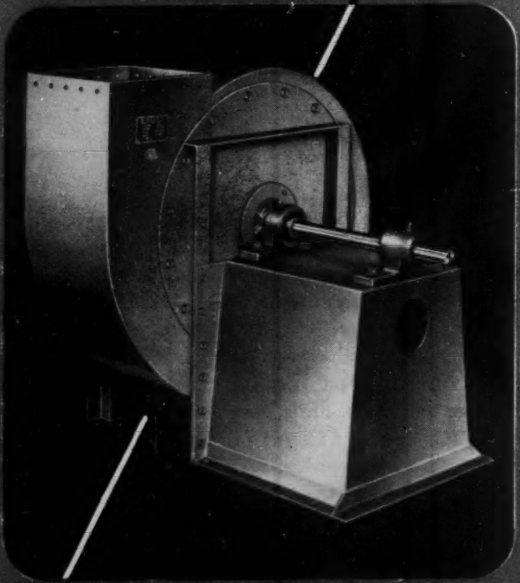
***Manufacturers of* A Complete Line of Boilers**
for Every Heating and Power Requirement

ALADDIN

FANS



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- DEPENDABLE

ALADDIN Industrial Exhaust Fans are ruggedly built and are especially suited for material handling or fume exhaust applications. They are ideal for removing dust from grinding wheels, conveying materials such as grains, shavings, sawdust, or the removing or handling of fumes, hot air or gases.

Units are all-welded steel plate construction . . . and are available with interchangeable "AR" Air Rotors, "MR" Material Rotors or "OR" Open Rotors.

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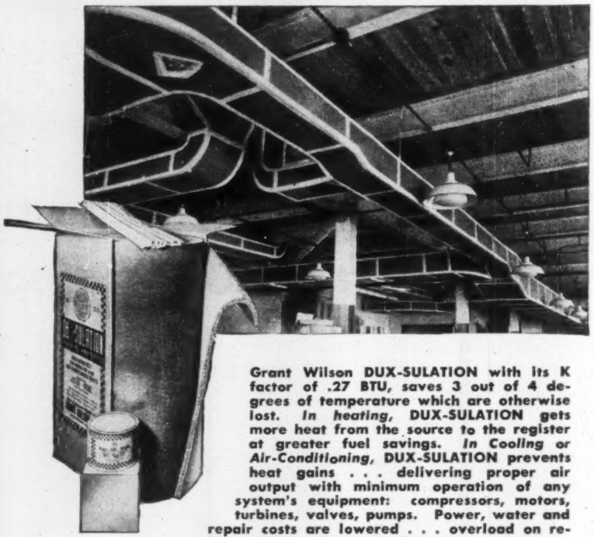
STOP *Temperature Loss!*



Grant Wilson DUX-SULATION with its K factor of .27 BTU, saves 3 out of 4 degrees of temperature which are otherwise lost. *In heating,* DUX-SULATION gets more heat from the source to the register at greater fuel savings. *In Cooling or Air-Conditioning,* DUX-SULATION prevents heat gains . . . delivering proper air output with minimum operation of any system's equipment: compressors, motors, turbines, valves, pumps. Power, water and repair costs are lowered . . . overload on refrigeration equipment relieved.

Other Advantages of Dux-Sulation on Duct Work: Condensation Prevention, Sound Absorption, Lower Surface Friction, Permanence, Good Appearance, Economy of Installation, Dependable Safety.

STOP

Noise!

Grant Wilson Woven Asbestos FLEXI-DUCT Tape stops noise and vibrations in all duct systems by isolating them at their source. Mechanical rattles, starting and stopping screeches, shaft whine, fan hum . . . all natural attendant noises to a blower' operation . . . can be confined to the blower housing by incorporating a flexible joint made of FLEXI-DUCT tape. Installation of such a joint is simple . . . tape or bolt FLEXI-DUCT to equipment and duct work with little time and effort. Network of ducts can be easily sectionalized . . . positively precluding sound travel by conduction . . . by interspersing FLEXI-DUCT joints throughout.

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BARBER
COLMAN

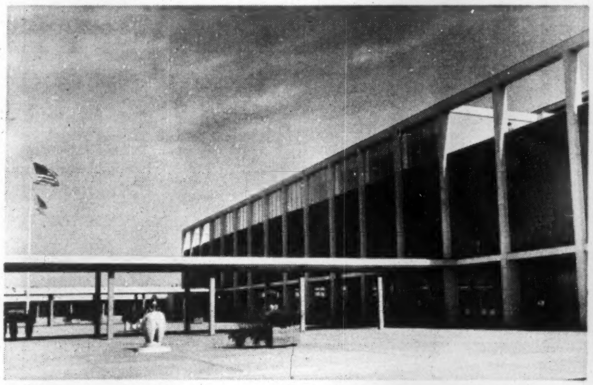
"UNI-FLO"
ENGINEERED

Air Distribution

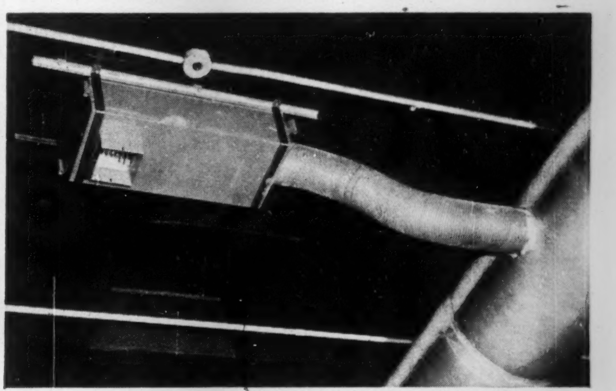
. . . at Hudson's in Northland Center

Close collaboration between consulting engineers, architects, store executives, air conditioning contractor, and the Barber-Colman laboratory staff has brought about one of the world's largest shopping center installations . . . at The J. L. Hudson Company's massive new branch store in $25,000,000 Northland Center, Detroit, Hudson's basement alone covers 18 acres, and the enclosed floor area totals 486,205 square feet. The entire store is air conditioned including selling areas, restaurants, lounges, offices and service departments.

Architects and Engineers: Victor Gruen Associates, General Contractor: Bryant & Detwiler Co.; Air Conditioning Contractor: Carrier Corporation; Mechanical Contractors: Donald Miller Company

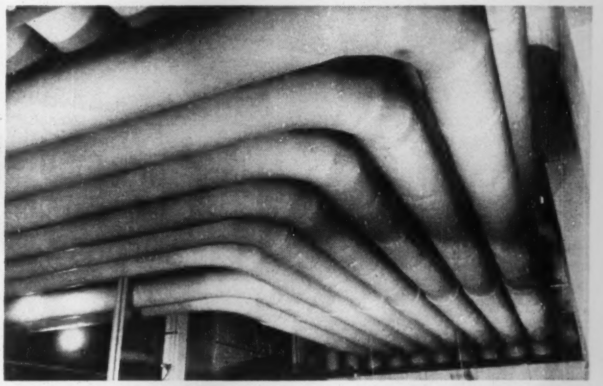


Contemporary design prevails throughout the world's largest suburban department store, exemplified by this view taken from the West Terrace. Complete edifice is air conditioned the year 'round for shopping comfort.



Uni-Flo Control Unit, suspended from ceiling, has flexible connection to branch duct. Control unit reduces pressure from approximately 6" to 8" H_2O down to low pressure for efficient distribution through diffuser.

Emphasis on beauty with practicality is the keynote throughout 186 merchandise departments. Note how the Uni-Flo Square Ceiling Diffusers blend harmoniously with the acoustical ceiling.



Wide angle view of part of trunk ducts in the fan room, connecting to air shaft at rear. Nearly eight miles of duct-work are required to carry conditioned air for just the first two floors.

BLAZING THE TRAIL *TO BETTER AIR DISTRIBUTION*

First with complete laboratory facilities . . .

When Barber-Colman entered the air distribution field nearly 20 years ago, laboratory facilities were established to simulate every possible condition of air distribution. From this laboratory has come reliable selection data . . . and many of the industry's pioneering developments.

Based upon years of laboratory research, plus field experience, Barber-Colman has the equipment and engineering "know-how" to help you design and install space-saving high velocity equipment for highly satisfactory results. Get latest data from our nearby Field Office (consult telephone directory), or write us. Our facilities and job-proved techniques are at your disposal.

BARBER-COLMAN COMPANY

Dept. K, 1101 Rock St., ROCKFORD, ILL., U. S. A. Field offices in principal cities

Air Distribution Products • Automatic Controls • Industrial Instruments Aircraft Controls • Small Motors • Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

Installing MICROLITE Duct Liner is as Simple as...

(coated or uncoated)

A
Cut required length and apply to sheet metal with adhesive

B
Form insulated duct section in brake

C
Use regular fabricating method
(no special procedure required)

Precision cutting and fitting of separate pieces, as with rigid insulation, is just not necessary. Microlite glass fiber duct liner is soft, pliable, pleasant to handle (no itching!) and as simple as A B C to install.

And that's just half the story. Microlite duct liner is a wonderfully efficient acoustical and thermal insulation.

Look:

Sound Absorption Value: ½″ liner has a noise reduction coefficient of .60; 1″ of .80.

Thermal Qualities: "k" value of .20 at 50°, .21 at 75°, .23 at 100°, .27 at 150°, .31 at 200°.

Featherlight too. One-inch liner with coating on one side weighs less than 2¼ ounces per square foot. Excellent air erosion resistance also. Coated liner is recommended for velocities of 1500 feet per minute or over. For velocities up to 1500 feet per minute, uncoated will peform satisfactorily.

For a technical bulletin and sample, and name of your nearest distributor, write to Glass Fibers Inc., 1810 Madison Avenue, Toledo 2, Ohio.

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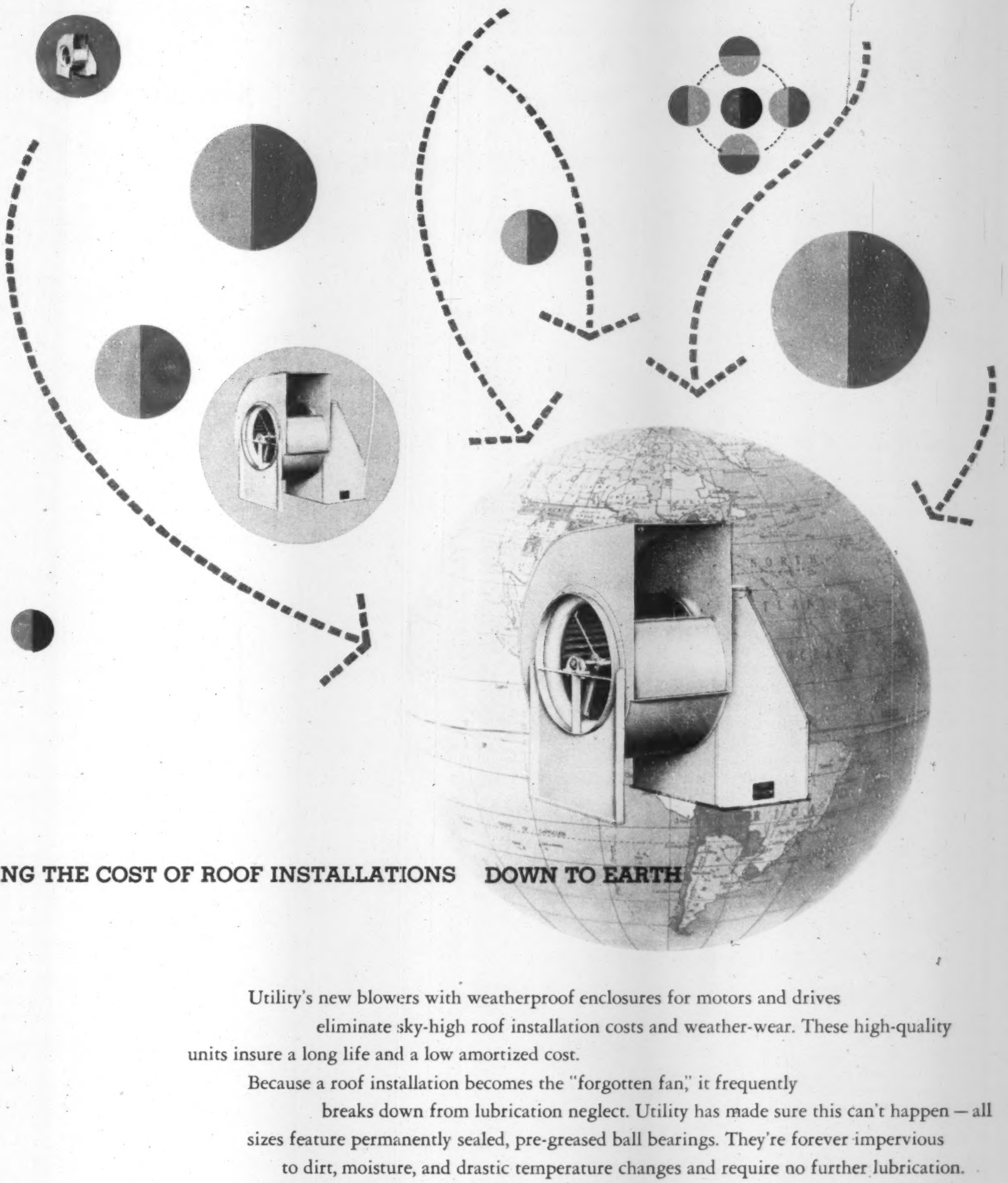
GLASS FIBERS INC.

Makers of glass fibers by the ELECTRONIC-EXTRUSION process ... developed, patented and used exclusively by Glass Fibers Inc.



BRING THE COST OF ROOF INSTALLATIONS DOWN TO EARTH

Utility's new blowers with weatherproof enclosures for motors and drives eliminate sky-high roof installation costs and weather-wear. These high-quality units insure a long life and a low amortized cost.

Because a roof installation becomes the "forgotten fan," it frequently breaks down from lubrication neglect. Utility has made sure this can't happen — all sizes feature permanently sealed, pre-greased ball bearings. They're forever impervious to dirt, moisture, and drastic temperature changes and require no further lubrication.

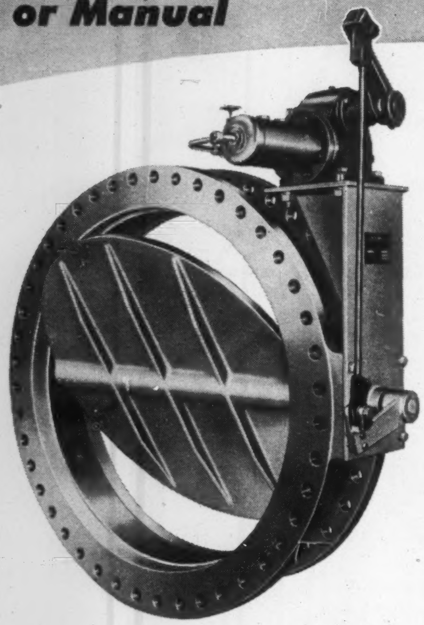
Manufacturers of heavy and standard duty blowers for heating, air conditioning and ventilating installations. Producers of blowers and blower parts for original equipment manufacturers. Write for catalogue data.

UTILITY FAN CORPORATION 911 East 59th Street, Los Angeles 1, California

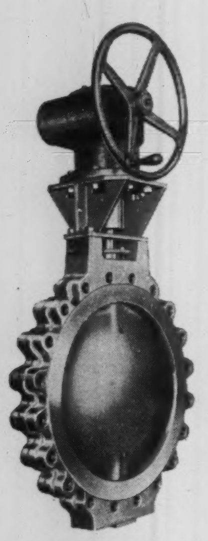
A DIVISION OF UTILITY APPLIANCE CORPORATION

VALVES for AIR • GASES LIQUIDS • SOLIDS

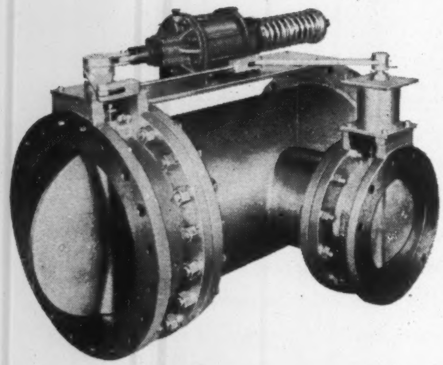
Automatic or Manual



W. S. Rockwell 54" butterfly valve for low pressure air line in a power plant; equipped with automatic crank type air cylinder operator.



W. S. Rockwell 24" heavy duty, wafer butterfly valve with gear type handwheel operator to handle recirculating water to 125 p.s.i. at 125° F. in steam power plant.



W. S. Rockwell 3-way butterfly valve, 24" size on line and 14" on branch; operated by spring-loaded hydraulic cylinder and special safety controls against power failure. Handles air and exhaust gases to 60 p.s.i. and 350° F. in gas turbine units of 5000 KW generators.

These are examples of the many butterfly, slide and special valve types, Rockwell-designed and built, for industrial applications. What's your problem?

W. S. ROCKWELL COMPANY

ROCKWELL SINCE 1888 BUILT

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

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See your Taylor Forge Distributor for up-to-the-minute facts

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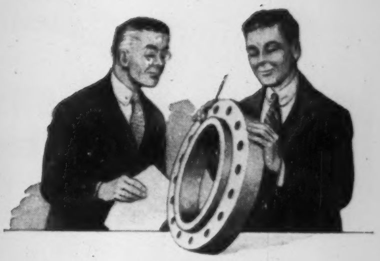
Offices in all principal cities • **Plants at: Carnegie, Pa.; Fontana, Calif.; Gary, Ind.; Hamilton, Ontario, Canada**



We had to quit guessing in the twenties

The founder of Taylor Forge used to say that "uniformity of strength should be the final goal of every engineer"... and no doubt this kind of thinking motivated the Taylor Forge organization to take so much initiative in the development of forged steel components for pressure piping.

The pattern was set in the twenties. Before 1920 little had been done in the way of pipe fitting and flange standardization. As early as 1905, however, Taylor Forge had produced forged steel flanges for Taylor pipe, and they had proved so superior to cast iron flanges that within a few years more flanges were being made for others than for our own use. But these forged flanges were bolted to the iron flanges of valves, pumps, and the like; so they simply followed cast iron standards.

In view of the obviously far greater strength of forged flanges, this was foolishly safe, and patently not at all in the "Uniformity of Strength" tradition. Moreover, in the twenties pressures were starting their upward climb. The 125 lb. and 150 lb. standard wouldn't do. Now it was 400; then 600; then 900 pounds. As the pioneer and leader in this field, Mr. Taylor saw the need for formulating standards and went to work on it.

Although one of the first studies conducted in this field, his work ranks to this day as one of the most thorough jobs ever done. In this work Mr. Taylor was in touch with Mr. Sabin Crocker, who is author of today's "Piping Handbook." He also collaborated with Professor E. O. Waters of Yale. Mr. Taylor ran exhaustive full scale tests on actual flanges to provide the test data which was then analyzed and formulated by Mr. Taylor and Professor Waters. The result was the Taylor-Waters Formula, presented before the ASME in 1927.

Still found in every engineering handbook, the Taylor-Waters formula was, and is, the basic means of determining flange stress under a given condition of loading. In the years since, Taylor Forge has also played a leading part in bringing standards into correlation with broadening needs . . . but this is *another* story.

An episode in the story of
Taylor Forge leadership in designed piping

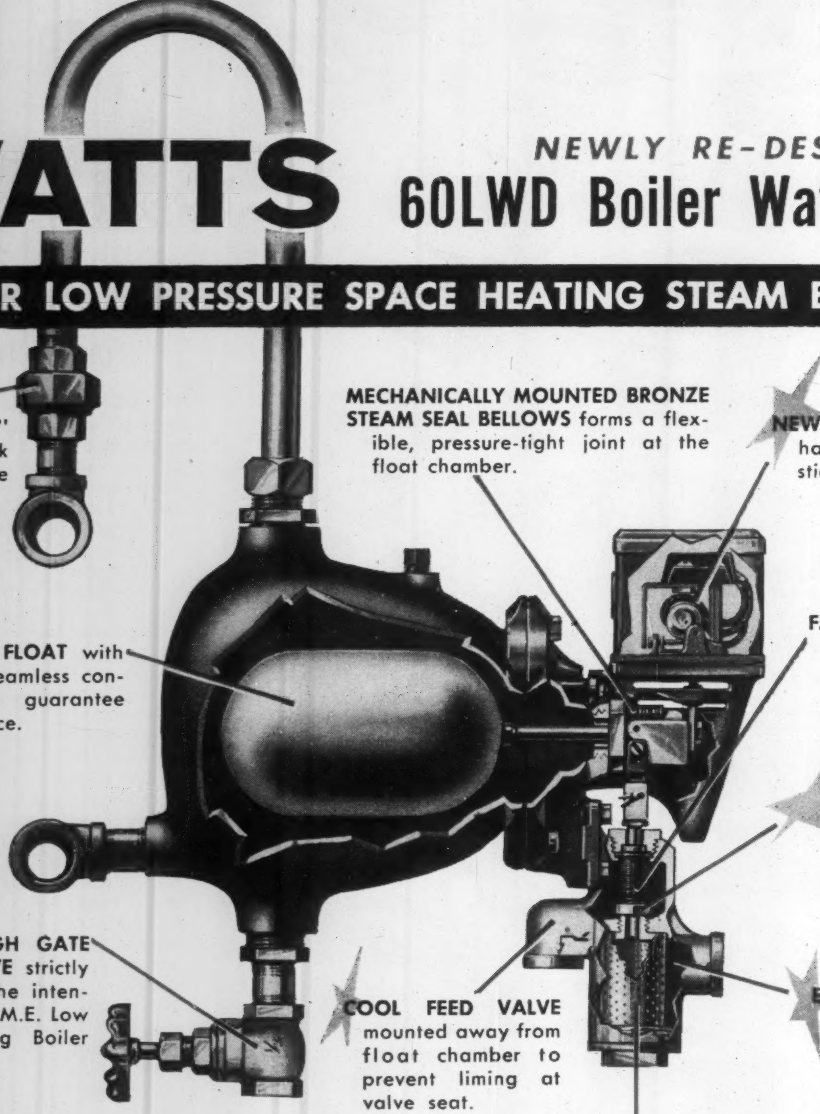
SINCE 1875

WATTS

NEWLY RE-DESIGNED

60LWD Boiler Water Feeder

FOR LOW PRESSURE SPACE HEATING STEAM BOILERS



QUICK HOOK-UP ½" fittings for quick and easy gauge glass connection.

MECHANICALLY MOUNTED BRONZE STEAM SEAL BELLOWS forms a flexible, pressure-tight joint at the float chamber.

NEW MERCURY SWITCH DESIGN has no mechanical parts to stick or fuse.

PURE COPPER FLOAT with reinforced seamless construction to guarantee lifetime service.

FATIGUE-RESISTANT bronze water seal bellows provides a pressure-tight seal and keeps the valve stem guide dry so that it cannot corrode or stick.

WATTS FEED VALVES feature resilient, stickage-proof disc-to-metal seating that will not leak.

STRAIGHT-THROUGH GATE TYPE DRAIN VALVE strictly complies with the intentions of the A.S.M.E. Low Pressure Heating Boiler Code.

COOL FEED VALVE mounted away from float chamber to prevent liming at valve seat.

ENLARGED STRAINER area and sediment space provides an ample free-flow safety factor.

HEAVY GAUGE perforated copper strainer. Easily removed for cleaning.

WATTS 60 SERIES. Recently added refinements to the proven design of the Watts No. 60 establishes its unquestionable leadership in today's design of boiler water feeders. No better protection can be found.

No. 60 boiler water feeder only (without cut-off switch) for manually-fired steam boilers. An LWD mercury switch assembly may be added in the field at any time to make a combination boiler feeder and low water cut-off for automatic firing.

No. 60LWD. This feeder consolidates the No. 60 with a mercury switch assembly to provide a combination feeder and cut-off with alarm switch.

Series 60 capacity up to 5,000 sq. ft. of radiation. Maximum steam pressure 35 lbs. Maximum water pressure 150 lbs. Has ¼" tapping for pressure switch. Water valve connections ½" S.P.S. Gauge glass connections ½" S.P.S. Height (float chamber only) 8½". Width 5½". Length 12½". Weight 30 lbs.

NOTE: These starred features above make Watts feeders the most advanced boiler water feeders available on the market today.

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LAWRENCE, MASSACHUSETTS U.S.A.

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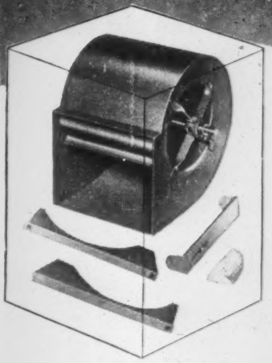
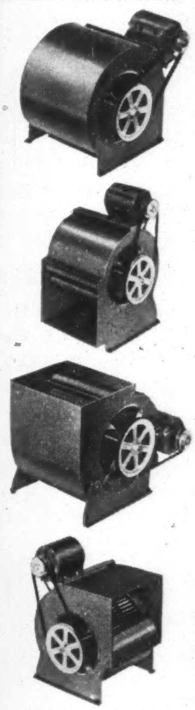
Brundage UNIVERSAL BLOWERS



Meets up to 80% of your applications



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YOUR SAMPLE BLOWER is just a phone call away. Ask for the sizes you want and *prove* Brundage superiority to your own satisfaction in your own laboratory.

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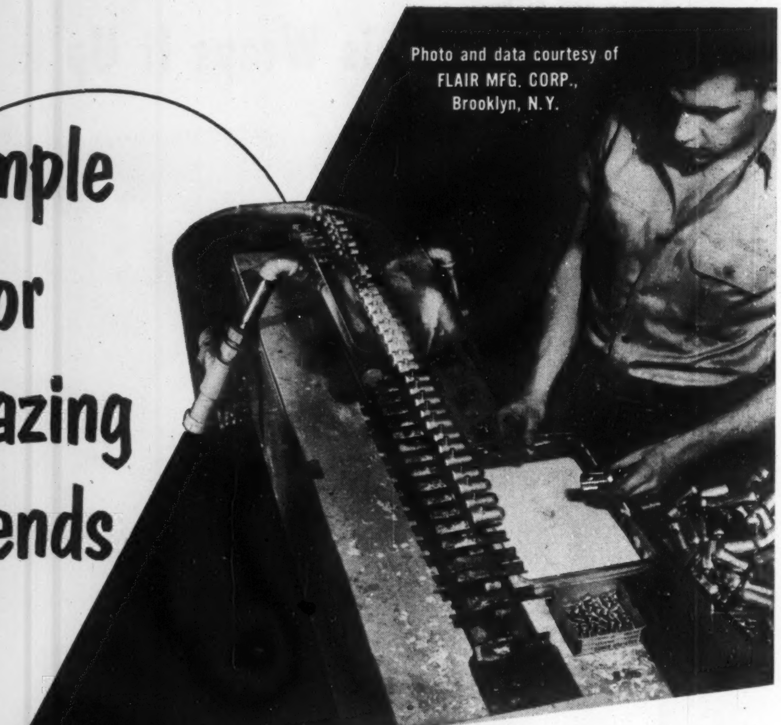
Amazingly simple EASY-FLO or SIL-FOS brazing pays big dividends



EASY-FLO RING

It's a safe bet you can get a better product at much lower cost on several of your metal parts by designing them for EASY-FLO or SIL-FOS silver brazed construction – supplemented by a simple production set-up that makes the brazing so easy – *anybody can do it!*

Here's an example – a radiator valve. It is made of a simple drawn body and a screw machine part, brazed with EASY-FLO. And the joining is done on a set-up that "automation-izes" the actual brazing. The net results – a smaller, trimmer valve – and a favorably low production cost.

EASY DOES IT – An endless chain runs at predetermined speed between a pair of city gas-air burners. Operator merely places bodies in angle-iron carriers, takes spuds with preplaced EASY-FLO rings, dips them in Handy Flux and sets them in bodies. The rest is automatic. Using only one row of carriers, output is 18 a minute.

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In cooperation with the manufacturer we worked out the valve brazing set-up – and we're ready to work with you. As originators of EASY-FLO and SIL-FOS low-temperature silver brazing alloys, we offer you the benefit of the maximum technical knowledge about the process and practical experience in its application available anywhere today. There's no obligation for this assistance. Just phone or write and say when you would like a field service engineer to call.

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Write for Bulletin 20. It gives them all plus a lot of useful information about fast, low-cost production brazing.

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REPUBLIC ELECTRUNITE

STAINLESS STEEL TUBING AND PIPE

● The distributors on this list all handle Republic ELECTRUNITE Enduro Stainless Steel Tubing and Pipe. Stainless Steel Tubing is electrically welded in 3/8″ to 5″ O.D. with wall thickness to 25 ga. to 8 ga., depending upon size. Stainless Steel Pipe comes in sizes from 1/8″ I.P.S. through 2″ I.P.S. in A.S.A. schedule 40S; from 1/8″ I.P.S. through 4″ I.P.S. in schedule 10S; and from 1/2″ I.P.S. through 4″ I.P.S. in schedule 5S wall thicknesses.

Both ELECTRUNITE Stainless Steel Tubing and Pipe are stenciled for your positive identification prior to use. No matter where the pipe or tubing are cut, they can still be identified.

When you need Stainless Steel Tubing and Pipe, call your nearest Republic ELECTRUNITE distributor. He'll be glad to supply you.

STAINLESS TUBING

Mechanical and Pressure

Size	Range (BWG)	Size	Range (BWG)
3/8″	16-25	1 5/8″	10-20
7/16″	16-25	1 11/16″	10-20
1/2″	14-25	1 3/4″	10-20
9/16″	14-25	1 7/8″	10-20
5/8″	14-24	2″	9-20
11/16″	14-24	2 1/8″	9-20
3/4″	13-24	2 1/4″	9-20
13/16″	13-24	2 3/8″	8-20
7/8″	12-23	2 1/2″	8-20
15/16″	12-23	2 5/8″	8-20
1″	11-23	2 3/4″	8-20
1 1/16″	11-22	2 7/8″	8-20
1 1/8″	11-22	3″	8-20
1 3/16″	11-22	3 1/4″	8-16
1 1/4″	11-22	3 1/2″	8-16
1 5/16″	11-20	3 3/4″	8-16
1 3/8″	11-20	4″	8-16
1 7/16″	11-20	4 1/2″	8-16
1 1/2″	10-20	5″	8-16
1 9/16″	10-20		

REPUBLIC ELECTRUNITE ® STAINLESS TYPE 304 HEAT#78910 SPEC-A-312
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ALABAMA
Industrial Piping Supply Corp., Bessemer
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Creamery Package Co. (Sanitary Applications) in many leading cities

STAINLESS STEEL PIPE

Pipe Size	Outside Diameter	Schedule 40S Wall	Schedule 10S Wall	Schedule 5S Wall
1/8″	.405″	.068″	.049″	.....
1/4″	.540″	.088″	.065″	.....
3/8″	.675″	.091″	.065″	.....
1/2″	.840″	.109″	.083″	.065″
3/4″	1.050″	.113″	.083″	.065″
1″	1.315″	.133″	.109″	.065″
1 1/4″	1.660″	.140″	.109″	.065″
1 1/2″	1.900″	.145″	.109″	.065″
2″	2.375″	.154″	.109″	.065″
2 1/2″	2.875″	.....	.120″	.083″
3″	3.500″	.....	.120″	.083″
3 1/2″	4.000″	.....	.120″	.083″
4″	4.500″	.....	.120″	.083″

Stainless Steel Pipe sizes are available in the chrome-nickel analyses and to a limited degree in the straight chrome types. Inquiries for larger diameters should be referred to your Steel and Tubes Division Representative.

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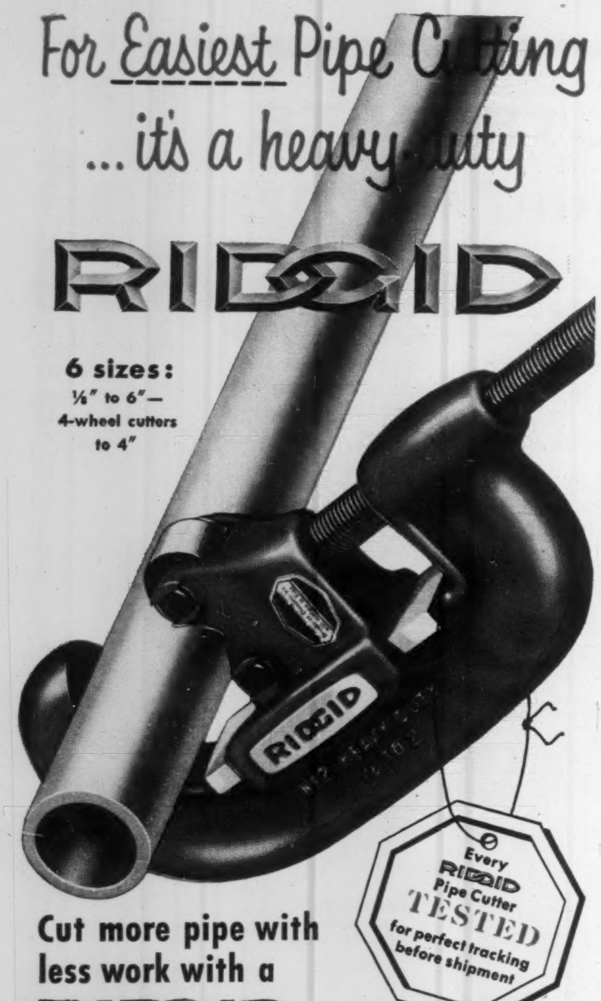
STAINLESS STEEL TUBING AND PIPE

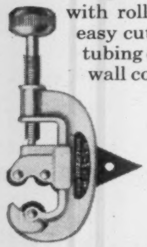
REPUBLIC STEEL ®



Cut more pipe with less work with a RIDGID

Once you've put a RIDGID Cutter on a pipe and seen how easily and cleanly it rolls through the metal, you won't want any other kind. Smartly balanced for easy action. Tracks perfectly—and special warp-proof malleable housing keeps it that way. High alloy thin-blade or heavy-duty cutter wheels, practically no burr. For fast cutting with least effort, ask your Supply House for a RIDGID.

RIDGID Tubing Cutter with rolls, fast easy cuts, any tubing or thin wall conduit.



3 Sizes for ⅛" to 2⅛" tubing

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U. S. A.

RIDGID

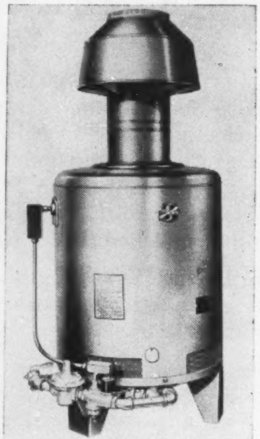
Work-Saver Pipe Tools

EQUIPMENT DEVELOPMENTS

From p. 216

New Water Heater

This new commercial water heater, model 718, has an input rating of 420,000 Btu per hr and will produce 403 gal per hr at 100 deg temperature rise, its manufacturer states. Approved by the American Gas Association for use with natural, mixed and manufactured gases, it is of the "Burkay" reverse flow type with nonferrous waterways and employs a copper finned heat exchanger with a coiled tubing combustion chamber. Controls include a gas valve, safety pilot and a high limit control. Overall dimensions are 27 in. diameter and 78 in. height, including the 10 in. diameter skirt type draft hood. A. O. Smith Corp., 3533 N. 27th St., Milwaukee 1, Wis.



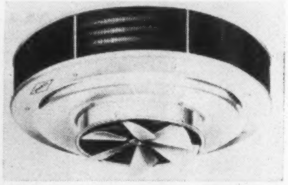
Air Eliminator

To prevent air from interfering with hot water circulation in radiant coils, baseboards or convectors, the air eliminator shown here is designed to break the water flow and cause air to separate. The air is then eliminated automatically through a vent while proper water line is maintained within the eliminator, the manufacturer states. H. A. Thrush & Co., Peru, Ind.

THRUSH
AIR ELIMINATOR

Downblow Unit Heater

The entire motor and fan may be removed from the bottom of a new downblow heater by loosening four bolts if servicing should be required. Its full die formed venturi, its manufacturer states, results in a very quiet unit. In four classes with either one or two row coils, the heater is available with outputs ranging from 40,000 to 580,000 Btu. Union Asbestos and Rubber Co., 332 S. Michigan Ave., Chicago, Ill.



Worn-out Gauge Glass . . . another reason for McDONNELL Boiler Controls . . .

Would you believe it—that a water glass can wear paper-thin from the inside out? Here is the factual story, plus actual photos, of one that did.

This particular incident occurred in an automatic steam heating plant in a large private residence near Chicago. The trouble broke while the owner was absent. When he returned the burner was stopped and the boiler room floor was wet.

The accompanying unretouched photos show the source of the trouble. The washing action of the boiler water had worn away the walls of the water glass until it finally broke, right above the lower packing nut. Note how the bottom of the glass had been worn paper-thin, in contrast to the still normal thickness at top of the glass.

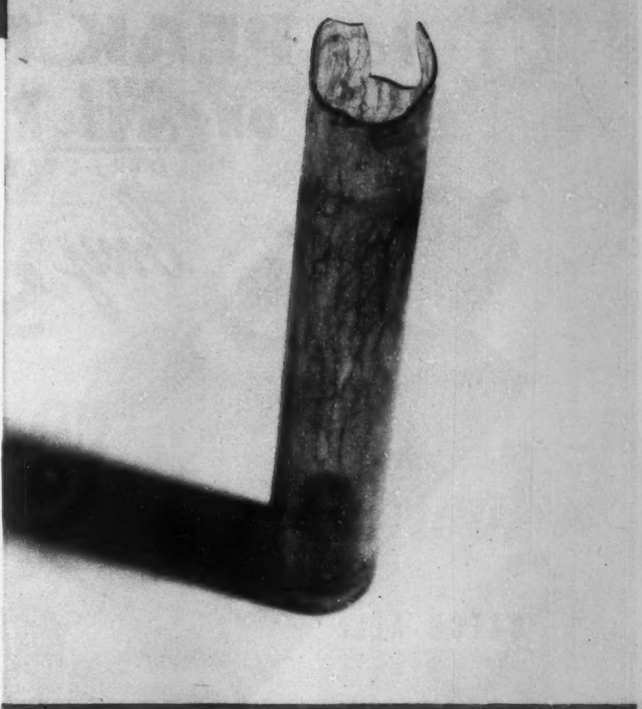
Fortunately, there was a McDonnell Low Water Fuel Cut-off on the boiler to stop the burner and prevent any further mishap.

A water glass would seem an unlikely spot to cause trouble. Certainly we don't often see such forceful evidence that it can actually wear out. But the moral is clear: Whatever the cause, when the water line heads towards the danger zone dependable McDonnell boiler water level controls represent the one final way to help guard against costly damage.

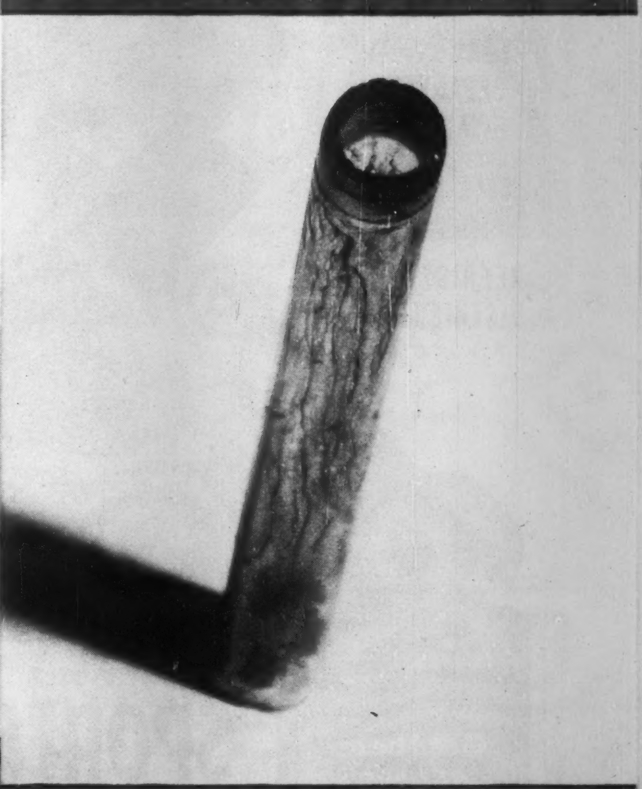
McDONNELL & MILLER, *Inc.*
3500 N. Spaulding Ave., Chicago 18, Illinois

Your Jobber Stocks Them

Doing One M&M SAFETY CONTROLS *Thing Well*



Unretouched photo of lower end of water glass, showing how washing action and erosion had worn walls paper-thin.



Top end of same glass, showing original wall thickness.

McDONNELL

Boiler Water Level Controls

for PEAK PERFORMANCE on *All* Refrigeration Systems

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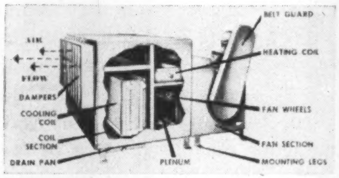
EQUIPMENT DEVELOPMENTS

Continued

Multi-Zone Air Conditioner

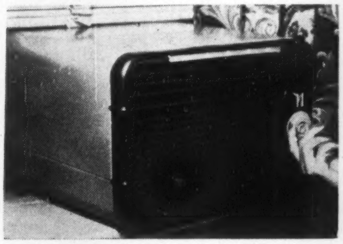
A new multi-zone air conditioning unit designed to supply the individual temperature and humidity requirements of as many as 12 zones in a building maintains constant temperature in various zones regardless of variations in building construction, its manufacturer says.



Of the blow through type, the unit forces air over either cooling or heating coils or a combination according to the demands of the zones. Two non-overloading, backwardly-inclined blade fans operating in a pressure chamber constitute the fan assembly. The unit is available in seven sizes ranging from 1665 to 21,000 cfm. Westinghouse Electric Corp., Sturtevant Div., Dept. 237, 200 Readville St., Hyde Park, Boston 30, Mass.

Air Purifier

A new air purifier, designed "to effect relief for asthma and hay fever sufferers," removes 99.4 percent of airborne allergens from room air, its manufacturer states.



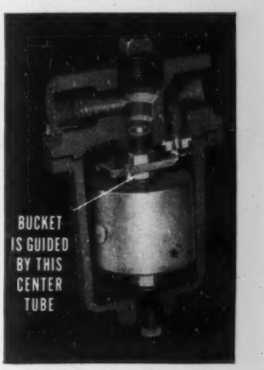
Using electrostatic precipitation as the method of purification, it is effective only where airborne irritants are the cause of suffering. Can be used as a window unit or a table model. Norge Div., Borg-Warner Corp., Merchandise Mart Plaza, Chicago 54, Ill.

C ONTROL IS VITAL
in Steam Traps too!

SUPER-SILVERTOPS LAST LONGER
The Patented Guided Bucket Is Controlled by a Hexagonal Tube

Uncontrolled action inside a steam trap causes trouble. In Super-Silvertops every moving part is "guided" in a true engineering manner. The Super-Silvertop bucket, unlike other traps, is carefully directed on a hexagonal tube. This patented arrangement gives Super-Silvertop users proper venting of condensate and air for a longer period of time. All parts are always in perfect alignment . . . the bucket can't hit the side walls . . . valve must close positively and firmly against the seat. That's why Super-Silvertop cuts the cost of steam trapping . . . and reduces trap maintenance.

Insist upon Super-Silvertops, stocked by leading jobbers everywhere.



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SUPER SILVERTOPS
The Controlled Steam Trap

Quality Steam Traps Since 1886

SOLVING STEAM TRAP PROBLEMS
Choice of the right steam trap increases efficiency of equipment as much as 35%. This 36-page manual answers problems on sizing, installation and maintenance. Mail coupon for your complimentary copy today.

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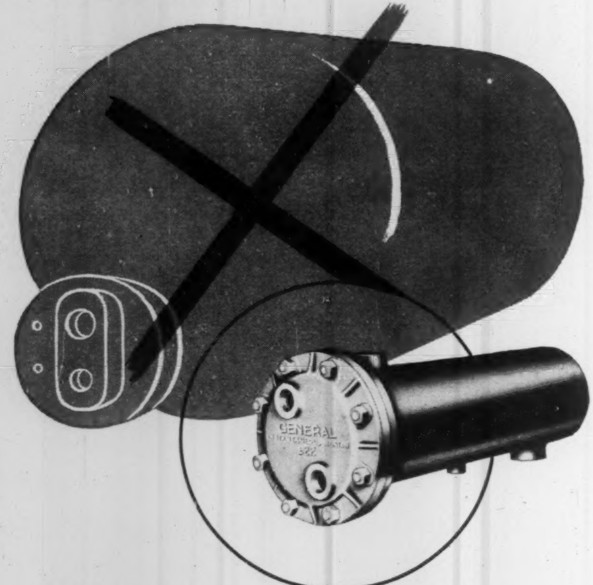
Heat Water the Modern Way ...without a tank



NOW YOU CAN HAVE a continuous hot water supply without installing a bulky storage system. General Instantaneous Water Heaters supply hot water as it is needed, and require a minimum of space. The largest model delivers 300 gpm and measures less than 2 ft. x 7 ft.

Installation is simple . . . whether on the floor or overhead. Merely tap the General Instantaneous Heater into your service line and connect a live or exhaust steam supply for heat source. Periodic maintenance is eliminated. Seamless copper tubing and bronze head and tube plates assure years of "clean" hot water supply.

You'll find a model to fit your needs among 21 sizes of General Instantaneous Water Heaters. Write for Catalog 61. General Fittings Co., Dept. A, 123 Georgia Ave., Providence 5, R. I.

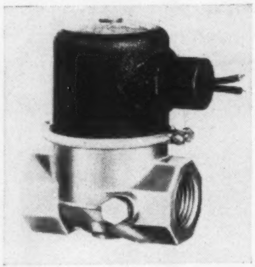
GENERAL
FITTINGS
COMPANY
GF
INSTANTANEOUS WATER HEATERS

EQUIPMENT DEVELOPMENTS

Continued

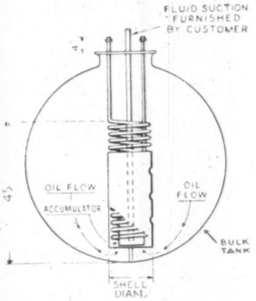
Magnetic Gas Valve

Designed to be free of valve closing impact noise and hum is a newly developed magnetic gas valve for unit heaters and gravity and forced air furnaces. Called the "K-3A," it is a soft seated type with a specially designed solenoid to make it humless, the manufacturer states. The valve opens and closes gas lines at the demand of room thermostats. The synthetic rubber valve disc settles against the valve seat when closed. It is brought to the shut-off position by spring action plus the pressure of gas, the company says. Valve is available in sizes $\frac{3}{8}$ to $\frac{3}{4}$ in. IPS. General Controls Co., 801 Allen Ave., Glendale 1, Calif. and Skokie, Ill.



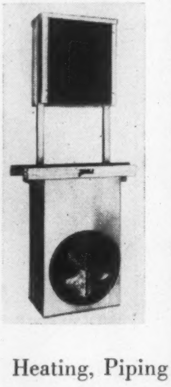
Preheater for Fuel Oil

To preheat heavy fuel oil to proper viscosity prior to introduction to the burner, the "Hot Spot" preheats the fuel before it reaches the suction line, its manufacturer reports. The unit is an all steel shell and coil assembly (no moving parts) that is designed for installation through the manhole of a bulk tank. It rests on the bottom of the bulk tank and inlet and outlet pipes for heat and suction go through the manhole cover. A flow accumulator causes the liquids to flow over heated pipes before entering the suction line. Is made in two sizes for $14\frac{1}{2}$ and $16\frac{1}{2}$ in. manholes. Rempe Co., 340 N. Sacramento Blvd., Chicago 12, Ill.



"Spot Cooler" Air Conditioner

Requiring no water or ductwork, this roof mounted cooler unit is self contained and looks and works like a space heater, its manufacturer states. Designed to be centered in "hot spots" within the plant building, each unit has a 2 ton refrigerating capacity. Multiple units can be hung from the ceiling throughout a large, open area for cooling. Simplaire, 521 Fifth Ave., New York 17, N. Y.

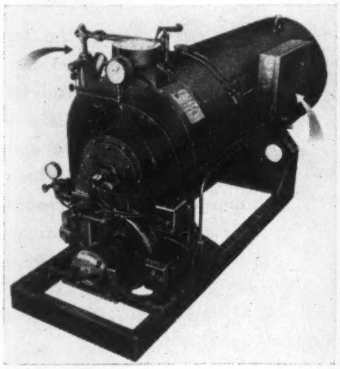


EQUIPMENT DEVELOPMENTS

Continued

Package Boiler Controls

The electronic controls that regulate the automatic operation of the 40 hp package steam generator shown here (model C1400) have been relocated for easier maintenance, the manufacturer states. The control box, formerly mounted on the boiler skids, has been moved to the side of the boiler jacket.



The water column has been moved to the left hand side of the unit as you face the boiler. The generator operates on gas, oil or a combination of both. It can be installed in an area 9 ft 2¼ in. long overall, 3 ft 5 in. wide, and 4 ft 7 in. high, the manufacturer reports. The boiler requires no stack. Cyclotherm Div., U. S. Radiator Corp., 157 E. First St., Oswego. N. Y.

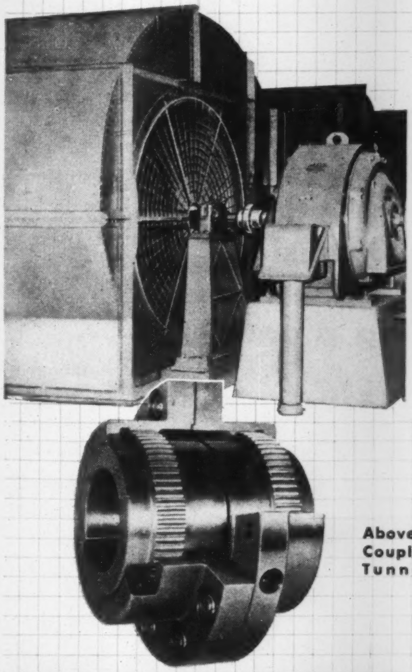
High Velocity Converter

A high velocity converter, which is an air flow adjusting device designed to regulate the flow of air out of high velocity supply ducts, thus permitting air conditioning at a low noise level and at a comfortable velocity, has been introduced. The device does this by reducing the static pressure in the vicinity of the outlet through the principle of static pressure regain. This converter will make possible the air conditioning of a room or area off a main, high velocity supply duct, without need for acoustical treatment, heretofore associated with this type of air conditioning, the manufacturer reports. The Pyle-National Co., 1373 N. Kostner Ave., Chicago 51, Ill.

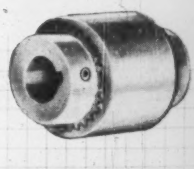
WALDRON
ADVANCED DESIGN
GEAR COUPLINGS
are available in all types and sizes for all applications

Whatever your drive problem, there's a WALDRON Coupling to meet it. All-steel couplings for rugged work, all-nylon couplings where the corrosion problem is present, combinations of both for a variety of special problems.

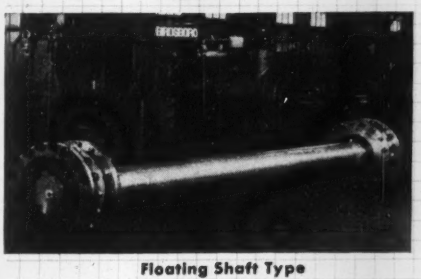
Whichever you use, the WALDRON design and construction is your assurance of long trouble-free service. The best known name in Couplings — WALDRON!



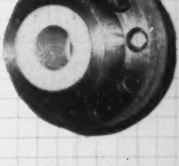
Above—Steel Coupling On Tunnel Fan



Above—All Nylon, Non-Corrosive Type



Floating Shaft Type For Steel Mill



Combination Nylon Hub and Steel Sleeve

WALDRON couplings are available in sizes up to 18″ shaft diameter. We specialize in furnishing couplings for unusual applications and services. We would be pleased to send you our latest bulletin 55M upon request.

JOHN WALDRON
CORPORATION
New Brunswick, N. J.
Since 1827

Sales Representatives In Principal Cities

Veteran's Admin. Hospital, Baltimore, Md.

Original installation or extension of existing heating plants—

Ray Service is always handy!

Wherever you are, whatever type of burner your specifications call for . . . a capable Ray Franchised Dealer is at your service to help you plan and to complete your burner installation.

Ray dealers are part of a team which has been growing in size and efficiency for 81 years. Modern facilities and techniques combine with experience to provide the best oil burner service you can buy. That is why today *"Every third rotary oil burner in service is a Ray"*.

Contact the Ray Dealer nearest you and take advantage of this complete engineering and installation service.

***Rely on your Ray Dealer*—you'll find his name in the yellow pages of your telephone directory.**

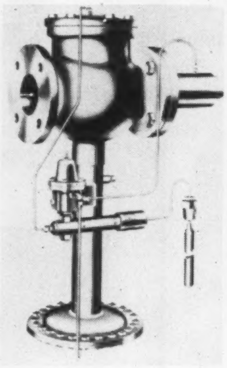
There is a Ray Burner for every purpose from 3 to 1,000 H. P. firing oil, gas, or gas-oil combination.

RAY OIL BURNER CO.

1301 San Jose Avenue • San Francisco 12, California
Atlantic Seaboard Div. • 679 Grove St., Jersey City 2, N. J.

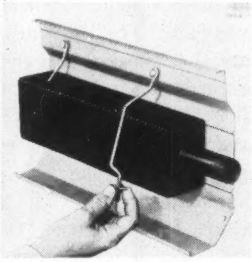
Temperature, Pressure Control Valve

Designed to prevent hunting, cycling, or overheating, a new single main valve gives pressure control as well as temperature control. Downstream pressure is sensed by the pilot valve which opens or closes to maintain set pressure. This is supplemented by the temperature control pilot which shuts the main valve when the temperature control point is reached. When control temperature falls below the set point, the main valve opens and the pressure reducing function resumes automatically. The pressure range is 5 to 125 lb. Temperature adjustment range is 50 deg. in standard ranges from 25-75, to 225-275 F. Klipfel Valves, Inc., 1075 Lincoln Ave., Hamilton, Ohio.



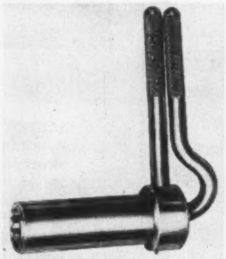
Baseboard Element Support Hanger

A new type of element support hanger for use with baseboard radiation has been developed to simplify installation as follows: A double headed nail assembly is used to nail back section of baseboard to ground strip on the studding. The "hooked" end of the new wire element hanger is slipped over the double headed nails and the speed nut is positioned on threaded end of hanger to support element. Front enclosure and accessories snap on and the job is complete, the manufacturer states. C. A. Dunham Co., 400 W. Madison St., Chicago, Ill.

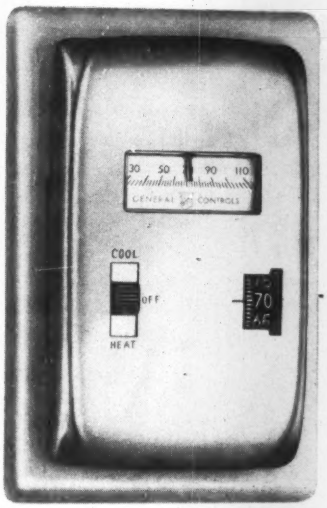


Nozzle Changer for Oil Burners

Consisting of four parts, this nozzle changer for oil burners is designed to slip over the nozzle and hold the adapter. The inside socket grips the nozzle for installation or removal, preventing slippage and damage to insulators, electrodes or nozzle assembly, its manufacturer states. A special feature is the offset handle to permit one hand operation. Delavan Mfg. Co., 811 Fourth Ave., West Des Moines, Iowa.



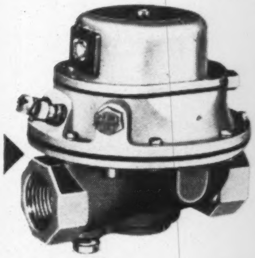
single point of control



for combination heating and cooling systems

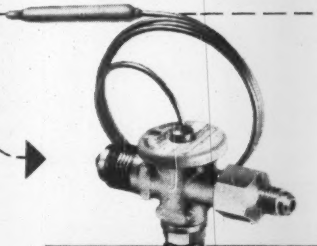
All year comfort is assured when General Controls' T-70H room thermostat is in charge of home heating and air conditioning. For cold weather comfort, set the easy-to-read temperature dial, move the indicator to "Heat" and that's all there is to it. Operating on millivolt current from a pilot generator the self-powered B-60 control system supplies healthful, dependable warmth all winter long. When hot weather comes, move the indicator to "Cool" and the air cooling system goes into operation on 24 volt current. For low cost, *high satisfaction* all year temperature control . . . it's automatic controls by General Controls.

for winter comfort, hundreds of thousands of American homes rely on General Controls automatic heat controls such as the famous self-powered B-60 gas control valve.



A complete product line with One source of supply, One responsibility

for summer automatic controls such as this selective orifice V-200 valve control the flow of liquid refrigerants to air cooling and refrigeration systems.



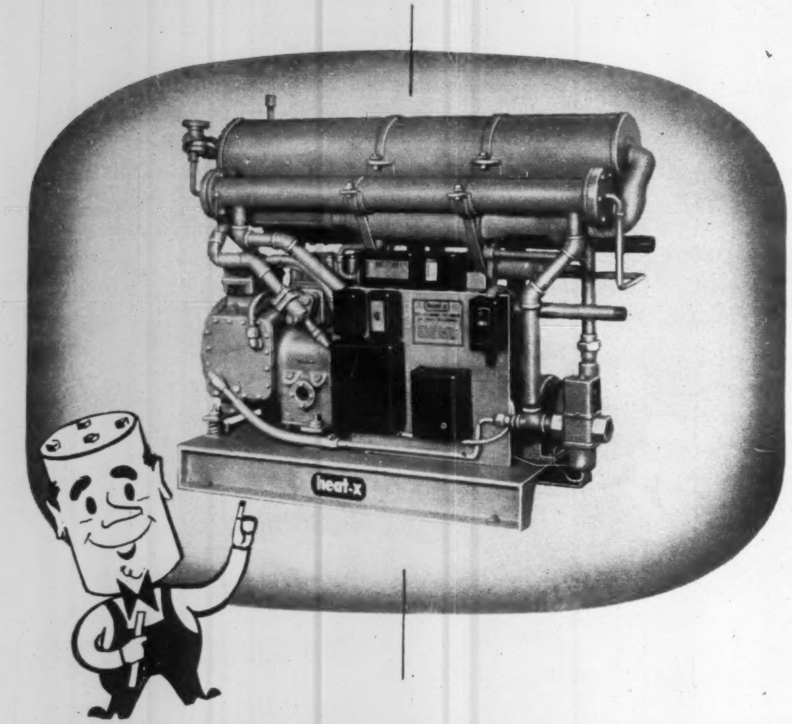
GENERAL CONTROLS
Glendale, California • Skokie, Illinois

Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls for Heating, Home Appliances, Refrigeration, Industrial and Aircraft Applications.

FACTORY BRANCHES IN 35 PRINCIPAL CITIES
See your classified telephone directory.

General Controls
T-70H
Heating-Cooling
Room Thermostat

THE NEWEST MEMBER OF THE
EXPANDING heat-x LINE ..
'PC' PACKAGE CHILLERS



"PC" Package Chillers, latest addition to the Heat-X line, are entirely self-contained . . . delivered completely wired and charged with Freon-12 . . . ready for plug-in operation.

All refrigerant passages are of INNER-FIN construction . . . a patented Heat-X exclusive . . . permitting compactness of design, efficiency of operation impossible with old style construction of other chillers.

These reliable, economical Heat-X Package Chillers, available in 2 HP. through 15 HP. models, are ideal for chilled water air conditioning systems, drinking water or beverage cooling applications, industrial water cooling uses.

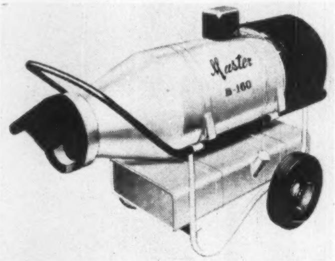
HEAT-X-CHANGER CO., INC.
BREWSTER • NEW YORK

EQUIPMENT DEVELOPMENTS

Continued

Portable Space Heater

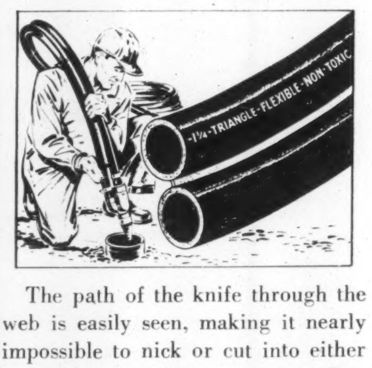
Actually a small furnace on wheels, this space heater can be rolled where needed and can spot-heat any outside or inside area, says its manufacturer. It is of all steel welded construction. Operates at the flip of a switch and rises to full heat in two minutes and will heat for 12 hr without refueling, the manufacturer says.



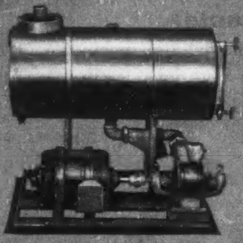
Heater has solenoid on the pump for flow and cutoff of fuel, fuel tank control to shut off burner when fuel supply is used up, and thermostat for temperature control. Burns kerosene, Nos. 1 or 2 fuel oil. Available in two models—160,000 or 400,000 Btu. Master Vibrator Co., 361 Stanley Ave., Dayton, O.

Duplex Plastic Pipe

Designed for installation of plastic pipe in double jet walls, "Duplex" consists of two pipes joined by means of a polyethylene web. This clear, translucent web facilitates separating the two pipes when they are to be connected into the pump or into the jet head.

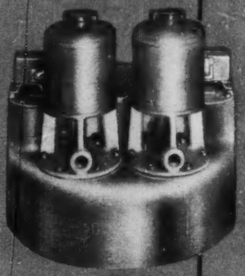


The path of the knife through the web is easily seen, making it nearly impossible to nick or cut into either pipe, the manufacturer states. Triangle Conduit & Cable Co., Triangle and Jersey Aves., New Brunswick, N. J.

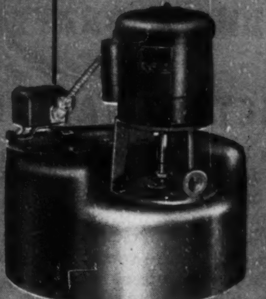


"TM" TURBINE PUMP
Designed for boilers up to 250 hp and discharge pressures up to 150 lbs.

"UV" CONDENSATE PUMP
Capacities ranging from 2,000 to 40,000 sq. ft. EDR, and discharge pressures from 10 to 75 lbs.



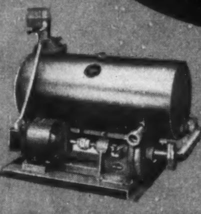
"CV" VERTICAL PUMP
Heavy duty duplex unit with two float switches. Capacities ranging from 500 to 10,000 sq. ft. EDR and discharge pressures from 10 to 20 lbs.



"CV" VERTICAL PUMP
Capacities ranging from 500 to 10,000 sq. ft. EDR and pressures from 10 to 20 lbs.

Skidmore Pumps

for top performance there is no equal



"HS" CONDENSATE PUMP
Capacities ranging from 1,000 to 65,000 sq. ft. EDR and discharge pressures from 10 to 75 lbs.

Let us tell you more about the many advantages of these famous SKIDMORE Pumps . . .

Let us send data —
Write us the type of Skidmore Pump you are interested in — we'll send brochure with full information.

- Compact, modern design — but readily accessible for inspection.
- Built to every installation requirement — in single and duplex units, assuring maximum efficiency.
- Completely assembled in wide range of capacities — pre-tested and ready for immediate shipment.

SKIDMORE PUMPS

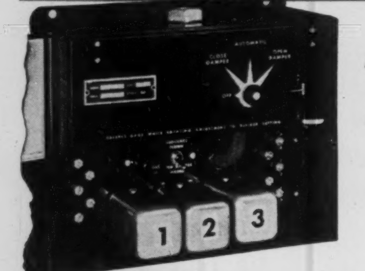
SKIDMORE CORPORATION ST. JOSEPH MICHIGAN

CONSULTING ENGINEER
all three agree...
INDUCED DRAFT ENGINEER
BURNER REPRESENTATIVE

INDUCED DRAFT SYSTEMS *need* SELECTED STARTING DRAFT!

A Draft Inducer is designed to provide a constant draft supply for maximum stack requirements. Without proper controls, it delivers maximum draft at all times. But under some conditions, this maximum draft needs correction—in particular during initial light off, whether on low-fire start, "high-low" burners or modulating burners, where excessive draft often causes starting failure or re-cycling.

CLEVELAND DAMPER CONTROL



provides the
4 CONTROL FEATURES
essential to safe efficient operation of
INDUCED DRAFT SYSTEMS

❶ **STARTING DRAFT SELECTOR**—providing pre-determined optimum draft for smooth, safe, ignition. When ignition is completed, damper control goes to full, automatic draft regulation.

❷ **AUTOMATIC DRAFT MODULATION**—maintaining ideal draft for proper combustion under varying firing rates and stack conditions.

❸ **AUTOMATIC SEQUENCE OPERATION**—providing proper draft for all phases of firing cycle, with proper shut-off of draft during "off" periods.

❹ **LOW DRAFT CUT-OFF**—providing the safety of an integral minimum draft switch that shuts down firing at unsafe low draft limits. Time-delay feature prevents nuisance shut-downs due to momentary puffs.

Only CLEVELAND DAMPER CONTROL can give ALL 4!

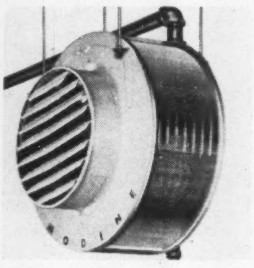
Write for complete information.

The CFE line includes damper controls, steam controls, electronic smoke detector control units, draft, air pressure and flue temperature gages.

COMBUSTION INSTRUMENTS & CONTROLS FOR EFFICIENCY AND ECONOMY

CLEVELAND FUEL EQUIPMENT COMPANY
1111 Brookpark Road, Cleveland, Ohio

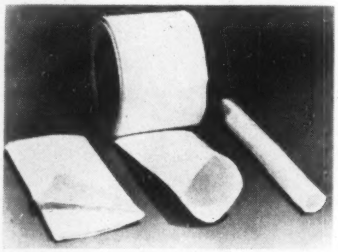
Horizontal Unit Heater



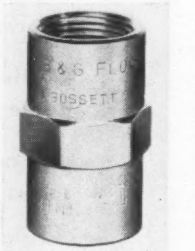
Designed to provide horizontal discharge of heated air at high velocities, a new unit heater is adaptable for use in large plants and warehouses, and to blanket large, frequently opened doors, its manufacturer states. Available models have capacities of from 271,000 to 609,600 Btu per hr. Adjustable louvers for directing output are standard equipment. Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.

Woven Fiber Glass Tubing

A new woven fiber glass tubular sleeving, said to be stretch resistant, is expected to find application in the heating and air conditioning industries, its manufacturer says. Is available in flat widths of from 1 to 6 in. and in continuous or cut lengths according to specification. An application under development is the use of narrow width tubes as containers for silica gel in refrigeration and air conditioning to absorb moisture. The principal advantage here is fiber glass's fire and heat resistant qualities. When the silica gel in the tubing becomes saturated with water the moisture may be removed by baking the complete unit in an oven. The container can then be re-used. Hess, Goldsmith & Co., Inc., 1400 Broadway, New York, N. Y.



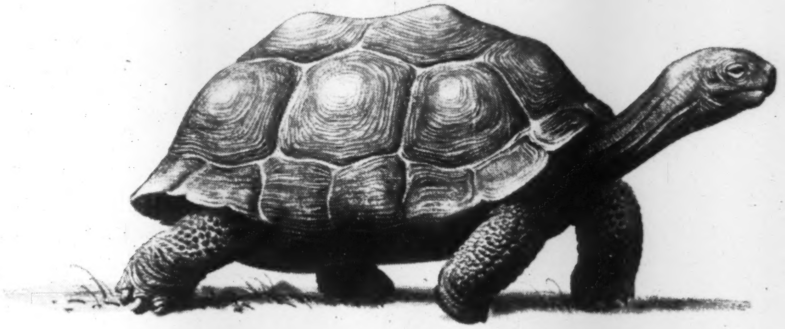
Flow Regulator



A new valve designed for the automatic control of the flow of water has applications in the heating field. Its manufacturer states it to be capable of controlling water through a wide range of pressures. Because of a self cleaning action while in operation, it is not easily clogged, the company states.

Of brass construction, valves are available in ½ and ¾ in. pipe sizes for capacities from 2 to 8 gpm. Bell & Gossett Co., 8200 N. Austin Ave., Morton Grove, Ill.

in refrigeration and air conditioning...



SLOW SPEED *means* LONG LIFE

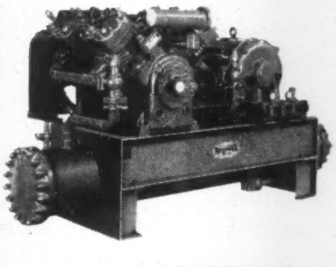
Why does the turtle live so long?

From an engineering viewpoint, the answer would probably be "Slow Speed!" Because the speed with which things *move* has a vital effect upon their life and usefulness, the design engineer is *always* concerned with doing *more* work with *less* motion.

BRUNNER slow-speed COMPRESSORS are good examples of this principle. Because they operate at speeds much slower than other compressors of the same capacities, Brunner Compressors deliver full capacity refrigeration and air conditioning with *less* costly motion — *less* wear on working parts, *less* maintenance required — and *lower* operating costs, too.

Brunner Application Engineers are glad to make recommendations. If you're planning to change or add to your line, investigate Brunner—for more Refrigeration and Air Conditioning profits for you. Write —

BRUNNER MANUFACTURING CO., Dept. L-114, UTICA, N. Y.
The Brunner Co., Gainesville, Ga.
In Canada: Brunner Corp. (Canada) Limited, Toronto, Ontario

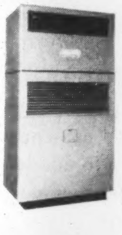


BRUNNER CONDENSING UNITS

— for commercial refrigeration and air conditioning applications are available in sizes from ¼ H.P. to 75 H.P.

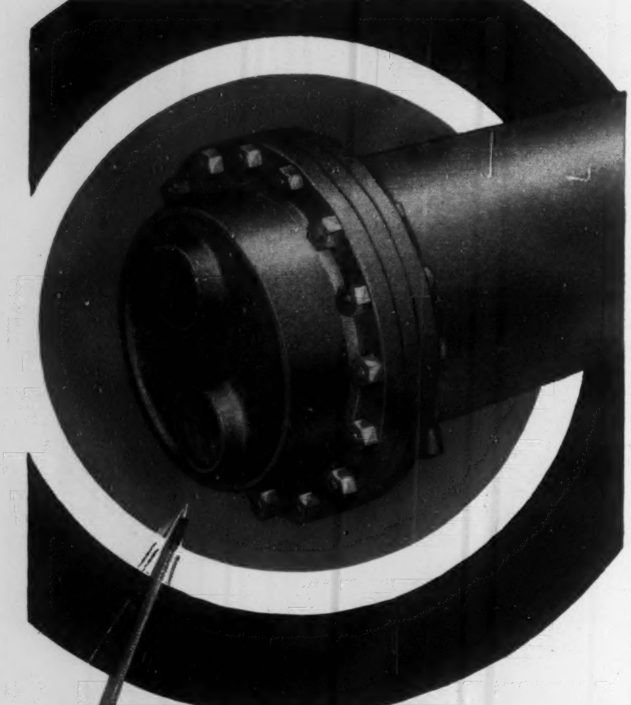
SELF-CONTAINED AIR CONDITIONERS

— completely packaged, easy to install and operate, are supplied in various models in sizes from 2 H.P. to 20 H.P.



BRUNNER
BRUNNER SINCE 1906

means dependable
refrigeration



HEATING and COOLING EQUIPMENT at its RUGGED DEPENDABLE BEST!

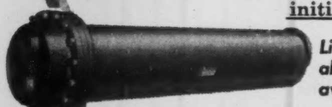
—CONDENSATE COOLERS —WATER CHILLERS
—FREON CONDENSERS—FUEL OIL HEATERS
CONVERTERS—INSTANTANEOUS WATER HEATERS

Top quality design and construction assure you of long life, plus low operating and maintenance cost with Manning & Lewis heating or cooling equipment.

Standard sizes and models are available for most applications, as well as being furnished of material for normal operating service. Special conditions will be satisfied by M & L engineers upon information submitted by mail or directly to our field representatives.

Heaters or coolers will be supplied to A.S.M.E. code requirements upon request.

With Manning & Lewis Heating and Cooling equipment "The initial cost is the last cost."



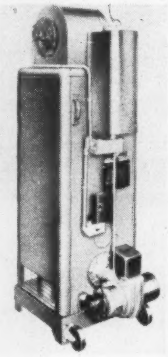
Literature pertaining to the above equipment immediately available upon your request.

2327

Manning & Lewis
Engineering Co.
M&L
32 Ogden Street Newark 4, New Jersey
SALES REPRESENTATIVES IN PRINCIPAL CITIES

Portable Heater

New electrical safety controls and a new venting stack are features of 1955 model "VO" 168,000 Btu portable heater. The new controls, consisting of a stack switch, fan limit switch and master switch, are grouped at the front of the machine. The stack facilitates attachment of an outside vent to permit use of the machine in confined areas, the manufacturer reports. The machine can also be employed without a vent or flue and direct preheated air back into the blower where it is further heated. The model operates from a detached fuel supply and uses regular furnace type oil or kerosene. Weighing 345 lb, the dimensions of the unit are 21 x 33 x 69 in. Burner is pressure atomizing. Fageol Heat Machine Div., R. D. Fageol Co., Kent, Ohio.



Acoustical Form Board

An acoustical form board, for poured-in-place gypsum roof decks, is designed to serve as a permanent roof deck form, as an interior ceiling, as an acoustical ceiling and to provide roof insulation. Light in weight, it is a barrier to heat and increases the insulating value of the deck, resulting in fuel savings. Owens-Corning Fiberglas Corp., 1911 Nicholas Bldg., Toledo 1, Ohio.

Equipment Briefs . . .

ULTRASONIC GAGE for measuring thickness and detecting laminar flaws. . . . The automatic "Vidigage" uses a 21 in. television tube. Thickness of metals, glass, etc. is indicated directly on large screen. Applications include corrosion surveys, corrosion inspection on gas cylinders, furnace tubes, process piping, etc. and gaging of tube bends and seamless tubes. Branson Instruments, Inc., Stamford, Conn.

NON-OXIDIZING SEALER to protect against moisture, dirt and air. The "No. 570.4" white-colored sealer is tacky, non-corrosive, non-drying, non-toxic and is adhesive to all clean surfaces, the manufacturer states. Presstite Engineering Co., 3798 Chouteau Ave., St. Louis 10.

NEW LIQUID FLUX, "Poly-Flux," is formulated to make solder flow and hold on iron and steel, its manufacturer states. Is said to remove surface oxides without resorting to harsh chemicals. Industrial Craftsmen, Inc., 145 High St., Boston 10, Mass.

You'll save up to 50 per cent with the new

SILENT DUCT

TRADE MARK

Pre-assembled metal and material pulls out flat and ready to use

THIS END UP
FAST, EASY METHOD SAVES UP TO
"SILENT DUCT"

LET'S PUT IT THIS WAY...you need some flexible duct connections. As the first step, you attach canvas or asbestos to strips of metal... a job that takes time and costs money. In shop after shop 50% to 60% is being *saved* today by using *Elgen Silent Duct*, the new connection material that comes to you pre-assembled for immediate fabrication.

Elgen Silent Duct is delivered in 100-foot (approx.) coils in a handy dispenser... *pulls out absolutely flat* and ready to use. It is made of 24-gauge galvanized steel, fastened to your choice of fire, water and mildew-resistant canvas (Govt. Spec. MIL-D-10860) or to heavy, top quality asbestos.

Order *Elgen Silent Duct* from your jobber and make savings that really help you get business. If necessary, ask us for your nearest source of supply. And write us for new free folder that tells the whole *Silent Duct* story.

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Elgen Manufacturing Corporation,
Dept. B-11, 41-34 39th St.,
Long Island City 4, New York

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SILENT DUCT

SAVES ASSEMBLING CONNECTION MATERIALS

PROBLEM:
"We need a new heating system, but can't afford an expensive one."

SOLUTION:
"We saved $6000 by installing **Delta OIL-FIRED UNIT HEATERS** in our plant!"

"We had neither the space nor the funds to install a complex boiler system . . . and the cost of gas in this area was too high for our budget. So we struggled along with inadequate heating . . . until Delta direct-fired Oil Unit Heaters solved our problem. They're doing a big job at an unbelievably low cost!"

Delta DIRECT-FIRED OIL UNIT HEATERS

fit everybody's budget, everybody's needs.

SIMPLEST TO INSTALL: Big savings on installation costs. They need no large chimney, boilers, pipes, fittings. Factory wired and assembled . . . just hang them up.

LOWEST COST OPERATION: Delta's powerful pressure oil burner does a most effective and efficient heating job on low cost #2 fuel oil. Maintenance is simple and seldom. Costs 50% less to operate than old-style systems.

GREATEST COMFORT: Within seconds the Delta Unit Heater bathes the entire working zone with comfortable, even heat . . . with no cold spots, no overheating. Ten sizes from 112,000 to 220,000 BTU/hr. to meet all situations.

On your next installation, let DELTA OIL UNIT HEATERS solve all your price and performance problems.

AUTOMATIC D HEATING

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WRITE TODAY FOR INFORMATION

Delta HEATING CORPORATION
1 COLE STREET • TRENTON 8, N. J.

he's an A.C.E.
AIR CONDITIONING ENGINEER

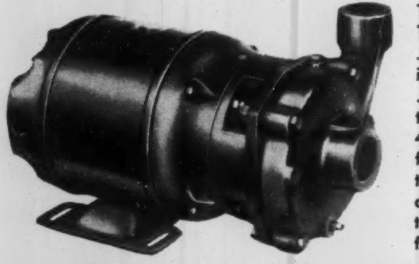
he's a C.P.S.
CENTRIFUGAL PUMP SPECIALIST

Both Experts in their fields . . . ready to aid you in YOURS!

Engineers specializing in Air Conditioning strive constantly to provide American industry with reliable climate controlled conditions that even out temperature extremes... providing greater efficiency through more comfortable working conditions.

Behind these capable experts, as well as others in all forms of heating and ventilating, you will find Weinman Centrifugal Pump Specialists, who wholeheartedly cooperate at all times to help solve pumping problems . . . and to supply pumps tailored to their specific needs . . . pumps that will deliver reliable, dependable continuous service.

If you're a heating and ventilating engineer, contractor or equipment manufacturer, you can eliminate your pump problems . . . permanently . . . by simply calling in an experienced Weinman Centrifugal Pump Specialist!



The WEINMAN Type AC Pump . . . mounts easily in limited space . . . in any position. Adjustable 4-way discharge facilitates location of pump and of recirculation lines. Write for Bulletin 725.

Representatives in principal cities

[illegible] Centrifugal Specialists
The WEINMAN Pump Mfg. Co.

EQUIPMENT DEVELOPMENTS

Continued

"JETWELD 2 HT" ELECTRODE is designed for speed welding of high tensile strength joints. Typical stress relieved values reported by the manufacturer are: tensile, 76,700 psi; yield, 64,300 psi; elongation, 27 percent. Is available in 7/32 in. diameter. The Lincoln Electric Co., 22801 St. Clair Ave., Cleveland 17, Ohio.

HARD RUBBER "O" RINGS are replacing leather cups in manufacturer's line of reducing and float valves. The new rings are said to provide longer service life, be better sealing and be more satisfactory for use at higher temperatures. Atlas Valve Co., 280 South St., Newark 5, N. J.

COMPACT DRY COLLECTOR for airborne granular dust is designed to eliminate fly ash from coal burning power plants. Called the "AMERclone", it is made up of conical shaped iron tubes that give the air a tornado-like twist, throwing the larger dust particles to the outside, while the clean air goes through, the manufacturer says. American Air Filter Co., Inc., 373 Central Ave., Louisville 8, Ky.

FOR CLEANING OIL BURNER PARTS, "Siloo," according to its manufacturer, removes carbon, sludge, gum, grease, etc., quickly and effectively. Each quart sized can contains a cleaning basket. Petroleum Solvents Corp., 331 Madison Ave., New York 17, N. Y.

SERIES "200" FLEXIBLE PLASTIC PIPE, made of polyethylene resin, is nontoxic and rot-, rust- and corrosion-resistant, its manufacturer states. It is designed to be lightweight and requires no special tools to install. Quaker Rubber Corp., Div. of H.K. Porter Co., Inc., Tacony and Comly Sts., Philadelphia 24, Pa.

POLYPHASE INDUCTION MOTORS, the manufacturer's line "Tri-Clad '55'," are now available in ratings from 1 to 5 hp. NEMA frame sizes are 182, 184, 213 and 215. All ratings are available in totally enclosed models as well as the regular drip-proof enclosure, the manufacturer reports. General Electric Co., 1 River Rd., Schenectady 5, N. Y.

PIPE SURFACE THERMOMETER, designed to obtain temperature of ½ to 2 in. pipes and tubes, has a calibrated bimetal temperature sensitive element that is coupled thermodynamically to the pipe. Comes in two ranges, −50 to 250 F, and 70 to 370 F. The Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 64, Calif.

RECENT TRADE LITERATURE...

Valve Controls

Complete new 21 page catalog, L-54, fully describes "LimiTorque" valve operators. These operators eliminate the need for manual operation of valves, says the manufacturer. As the name implies, they limit the amount of torque applied to valve operating parts. Catalog shows operational details and illustrations.

Manufacturer—The Philadelphia Gear Works, Erie Ave. and G St., Philadelphia 34.

Electronic Controls

Current quarterly issue of *Instrumentation*, technical publication of Minneapolis-Honeywell's industrial division, reports round-the-clock production techniques in the processing of the polio-fighting serum gamma globulin. Also reports the design of a recording analytical scale used by the National Bureau of Standards to record the weight changes of complex minerals during "thermal decomposition."

Manufacturer—Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Avenues, Philadelphia 44.

Miniature Repeat Cycle Timers

Two page bulletin RC200 contains information on a new line of miniature hermetically-sealed repeat cycle timers. Describes cycling time, timing accuracy, detail characteristics and determination of timing tolerances.

Manufacturer—The A. W. Haydon Co., 230 N. Elm St., Waterbury, Conn.

Needle and Globe Valves

Bellows seal type. Four page leaflet covers service type, service range, sizes available, connections, materials and special features.

Manufacturer—The Associated Valve & Engineering Co., 1150 W. Marquette Rd., Chicago 21.

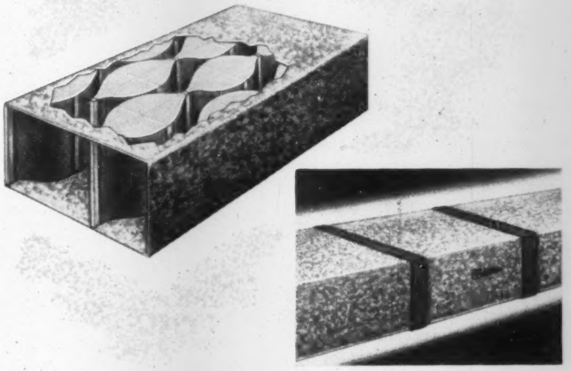
Cutting and Welding

A new condensed 50 page catalog, No. ADC 662 B, describes and illustrates all "Airco" products regularly used by job shops, maintenance departments and other users of light welding and cutcutting attachments for torches. The catalog explains ting equipment and accessories; also, three of the latest developments—"Aircospot" inert gas spotwelding, "Easyarc" 12 electrode and the new heavy duty cutting attachments for torches. The catalog explains how each item operates and the jobs to which it is best suited. Complete specifications and stock information is supplied.

Manufacturer—The Air Reduction Sales Co., 60 East 42nd St., New York 17.

AT LAST . . . THE ANSWER TO AIR CONDITIONING NOISE

AIRCOUSTAT PROVIDES PACKAGED SILENCING OF AIR AND FAN NOISES



CHECK THESE ADVANTAGES:

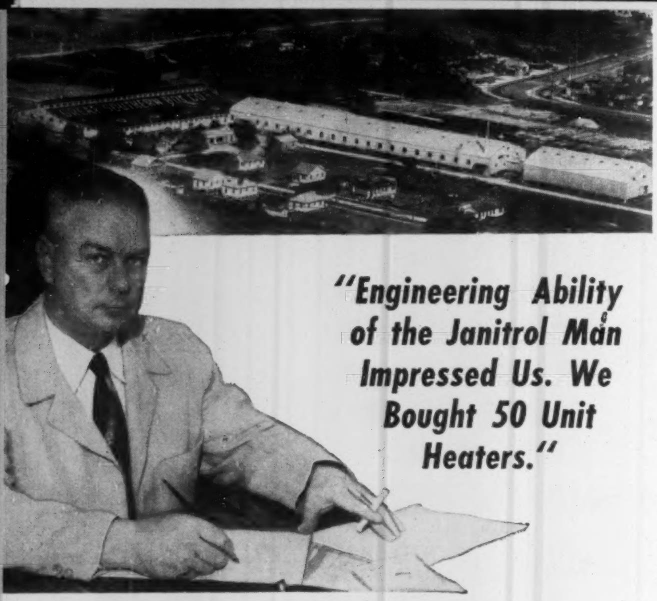
- ✓ 7 foot unit reduces noise level below what 100 feet of duct lining could accomplish.
- ✓ Pressure drop less than lining entire duct.
- ✓ Selection is no problem. If it fits geometrically, it fits acoustically.
- ✓ Easy to install. Only simplest tools needed.
- ✓ Constructed of galvanized steel or aluminum for long-life durability.
- ✓ Available in 11 standard sizes from 6" x 6" to 48" x 56" for use with all styles and sizes of ducts.
- ✓ Acoustically engineered to assure correct silencing of conditioned areas.

WRITE TODAY FOR COMPLETE SPECIFICATIONS

INDUSTRIAL SOUND CONTROL, Inc.
45 Granby St., Hartford, Conn.
Please send me more information on AIRCOUSTATS.
Name
Address
City State

SILENCE SERVICE

Industrial Sound Control Inc.
45 Granby Street, Hartford 12, Conn.



"Engineering Ability of the Janitrol Man Impressed Us. We Bought 50 Unit Heaters."

Statement by Paul E. Olivier, General Supt. Great Southern Box Co., New Orleans, La.

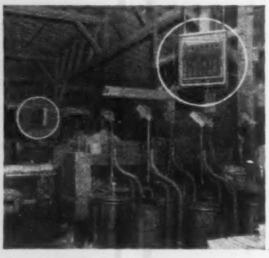
Starting with 8 Janitrol Unit Heaters in their Wirebound Box Plant in 1942 the Great Southern Box Co., Inc. found this a practical and economical answer for their heating problems. Janitrol gas units kept installation costs to a minimum . . . no costly steam pipes were needed.

Plant expansion in 1944 required 12 additional Janitrol units for the new Corrugated Section . . . and in 1946, 27 similar units were installed in their new plant in Jackson, Miss. Several units have also been installed in their Cleated Corrugated Plant in Jackson, Miss.

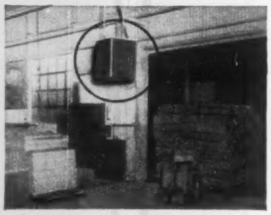
Mr. Olivier, said, "All of our heating requirements have been met with Janitrol Unit Heaters. There is no question that Janitrol engineering features assure long trouble-free service."

Sawdust in the air in the wooden box plant covers the Janitrol Units and makes occasional cleaning necessary—yet no maintenance problems have arisen, even under these rugged conditions!

Look into the *plus* features of gas heat with Janitrol for *your* needs!



All heating units are around the perimeter of the big 440′ x 90′ building.



Janitrol units in the paper box building cover eight shipping doors to provide a curtain of warm air during loading operations.

Write today for "The Business Man's Blue Book for Better Heating." It gives full details about unit heater performance and best installation practices.

Janitrol
GAS-FIRED UNIT HEATERS

Janitrol Division of
SURFACE COMBUSTION CORP.
400 Dublin Ave., Columbus 16, Ohio
In Canada: Alvar Simpson Ltd., Toronto 13, Canada

ALSO MAKERS OF
Surface INDUSTRIAL FURNACES **Kathabar** HUMIDITY CONDITIONING

Cooling Towers

Three new items are described in circulars: 1) induced air, outdoor-indoor design cooling towers for residential, commercial use, sizes 7 to 16 ton capacity; 2) evaporative condensers, 2, 3 and 5 ton capacity; 3) floor type and window type room air conditioners.

Manufacturer—The Kauffman Air Conditioning Co., 4505 Olive St., St. Louis.

Dust Control

How to Control Dust in the Manufacture of Rubber Goods, four page bulletin No. 442, gives case histories of three different companies, showing how dust conditions are prevented or controlled. It explains the importance of product recovery, as well as the improvement of working conditions in the plant. With cloth filter type collectors, material is collected "with nearly 100 percent efficiency in a dry state, and is in a readily re-usable condition," the manufacturer states.

Manufacturer—The American Wheelabrator & Equipment Corp., 1321 S. Byrkit St., Mishawaka, Ind.

Electric Motors

A report on comparative tests of different brands. Information is presented in tabular form for engineering performance, comparison and in visual color charts as to what the results prove in relation to use. Four page brochure, No. 400.

Manufacturer—Electro Dynamic Motor and Generator Div., The General Dynamics Corp., Bayonne, N. J.

Pressure Recorders

Twenty-four page bulletin 6-10 graphically describes a new line of pressure measuring elements that have greater operating power and improved accuracy, the manufacturer says. An application chart, "How to Select the Measuring Element," shows the element materials available. The bulletin also describes case and linkage features, lists charts for standard process ranges, and covers accessories such as seals and pulsation dampeners. Also, there are sections on electronic pressure instruments, cabinets and panels, controllers, and transmitters.

Manufacturer—The Foxboro Co., Foxboro, Mass.

Strainers and Relief Valves

Catalog section 12-T includes newly designed union bonnet strainers in sizes 1¼ in. to 2 in. inclusive. Contains dimensions and design details, tips on the installation and maintenance of forged steel strainers and relief valves. Replaces relief valve bulletin 504 and strainer bulletin 505.

Manufacturer—Edward Valves, Inc., 1201 West 145th St., East Chicago, Ind.

PRUDENTIAL— AN EXAMPLE OF AIR CONDITIONING AT ITS BEST

Yes, there is a difference in air conditioning, just as there is in heating, automobiles, housing . . .

True comfort means maintaining BOTH HUMIDITY and temperature at optimum levels.

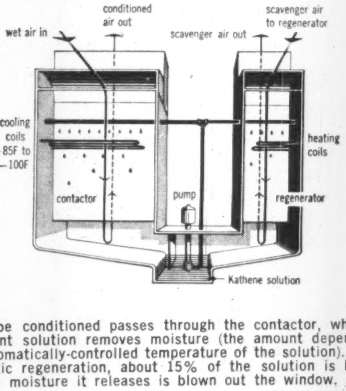
The Prudential Insurance Company of America has the right idea . . . direct dehumidification for humidity control, conventional cooling for temperature control. Here's how. Kathabar units continuously dehumidify a supply of outside make-up air to a moisture level which absorbs the moisture load of the entire building. This is done economically, with cooling tower water.

The air then is sensibly heated or cooled as needed in tempering coils, located throughout the building. Since the air is dehumidified before cooling, the surfaces of these coils are *dry*. Result, no musty odors, bacteria at a minimum, health at a maximum.

It pays to buy the best when selecting air conditioning. The combination of Kathabar for humidity control and conventional refrigeration or well water for temperature control is simple, economical. It is creating new high standards in air conditioning throughout the country.

The team has been equally effective in many industrial process air conditioning applications where dry air and/or low temperatures are required. Literature group K-54-8—which includes our new brochure "Humidity Conditioning"—will give you the complete story.

WHAT COULD BE SIMPLER?

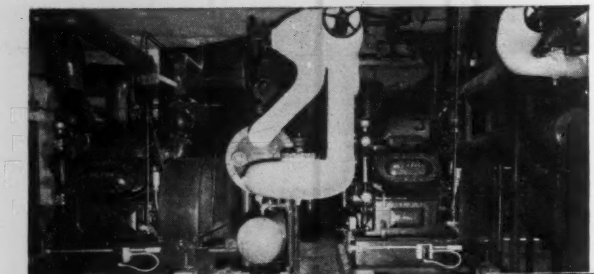


Air to be conditioned passes through the contactor, where an absorbent solution removes moisture (the amount depends on the automatically-controlled temperature of the solution). In the automatic regeneration, about 15% of the solution is heated, and the moisture it releases is blown out the window.

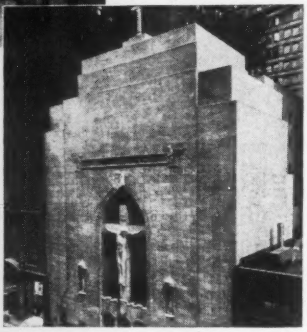
Kathabar®
HUMIDITY CONDITIONING

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

ALSO MAKERS OF **Surface** INDUSTRIAL FURNACES **Janitrol** AUTOMATIC SPACE HEATING



St. Peter's Franciscan Church and Friary, Chicago, Illinois



for modern comfortable
AIR CONDITIONING
in churches

CHECK with VILTER

In the very midst of the business area of one of the great metropolises of the world stands a working memorial to Christian living—the famous St. Peter's Franciscan Church and Friary, Chicago. Dedicated to serving Catholics in the area, it is a sanctuary for their spiritual needs.

Designed, too, to be a sanctuary from the heat, the entire church is air conditioned—60 rooms, including chapels, living quarters, study rooms, offices, and dining rooms. There are individual temperature controls for each section. Providing the refrigeration are four 65-ton Vilter VMC compressors. Quiet and efficient in operation, these units provide comfortable air conditioning in the entire edifice.

In structures where windows are at a premium, where valuable foodstuff is being processed or stored, where cool temperatures during vital manufacturing processes must be kept, Vilter refrigeration systems "fill the bill." They are dependable . . . trouble-free . . . keep operating and maintenance costs to a minimum. Vilter is well qualified by experience to handle your refrigeration problems in many fields.

Vilter

Your nearby VILTER Representative or Distributor will be glad to show you how VILTER refrigeration can help you.

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, MILWAUKEE 7, WIS.

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water and Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice and Polarflake Ice Machines

RECENT TRADE LITERATURE

Continued

Pumps

New 40 page catalog, No. 53-CI, shows condensation return, boiler feed and industrial pumps. Single-pump and duplex-pump systems are shown both in factory assembled systems and as components that can be assembled on the job. Performance characteristics for each system and pertinent engineering information is included.

Manufacturer—The Decatur Pump Co., Decatur, Ill.

Pumps

New bulletin, No. B-1700, *Hydro-Line Pumps*, describes and illustrates two types of vertical, encased, close coupled pumps for the handling of hydrocarbons, hot or cold water, mild acids, basic and salt solutions. It documents and illustrates the construction features of both a *process* type vertical can pump and a *transfer* type vertical can pump and points out where each may be advantageously and profitably applied.

Manufacturer — Peerless Pump Div., Food Machinery and Chemical Corp., 301 West Ave. 26, Los Angeles 31.

Automation Equipment

The Tools of Automation, a new 12 page booklet illustrates motors, adjustable speed "V-S Drives" and electronic controls and regulators for single machines or continuous processes. Photographs of automation at work in many industries are included.

Manufacturer—The Reliance Electric and Engineering Co., 1088 Ivanhoe Road, Cleveland 10.

Scale Control

Four page brochure gives description, specifications, illustrations and applications of scale formation control.

Manufacturer—Aqua Electric Scale Control, Inc., 2028 East 22nd St., Cleveland 15.

RECENT TRADE LITERATURE

Continued

Cooling Towers

The question, "How do cooling towers save you money?" is answered in a new four page catalog on "Flow-Cold" towers. Five models are illustrated and described, with capacities ranging from 3 to 15 tons. A selection procedure is given to enable the user to pick the model best suited to his purposes.

Manufacturer—Acme Industries, Inc., Dept. 402, Jackson, Mich.

Electronic Controls

The Electronic Control Story, new 24 page booklet, is designed for architects, engineers, contractors, and users of automatic controls for heating, ventilating and air conditioning systems. Booklet covers bridge circuit, sensing element, amplifier and special applications of temperature control.

Manufacturer — The Barber-Colman Co., Rockford, Ill.

Boiler Blowdown

A selection of seatless or hard-seat blow-off valves are illustrated and described in two new bulletins. Bulletin B-426 is for pressures to 400 psi, and B-434 for pressures to 2500 psi.

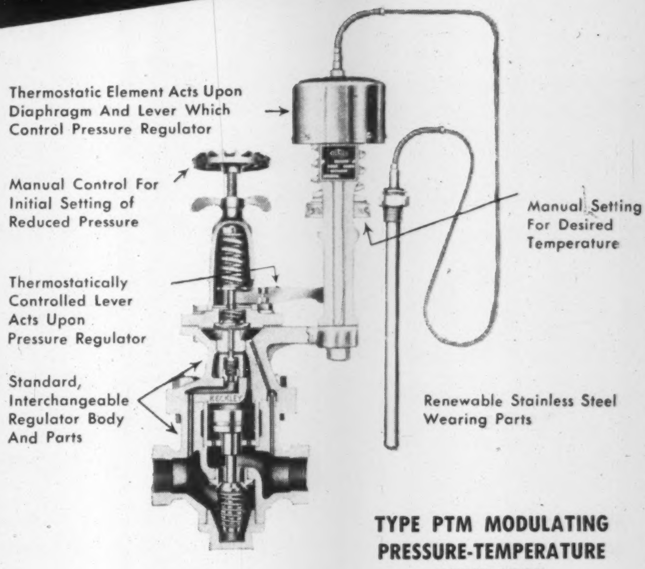
Manufacturer — The Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, Pa.

Oil and Gas Burners

New eight page brochure describes "Hydro Vacuum" burner. Says the manufacturer: it saves up to 50 percent on fuel; operates efficiently with low grade oils; performs without smoke, soot or carbon deposits; it has no moving parts; and no forced draft, fans or stack are necessary.

Manufacturer—Utah Hydro Corp., Salt Lake City.

THIS NEW KECKLEY REGULATING VALVE GIVES
Finer Temperature Control
THAN EVER BEFORE POSSIBLE!


Thermostatic Element Acts Upon Diaphragm And Lever Which Control Pressure Regulator
Manual Control For Initial Setting of Reduced Pressure
Manual Setting For Desired Temperature
Thermostatically Controlled Lever Acts Upon Pressure Regulator
Standard, Interchangeable Regulator Body And Parts
Renewable Stainless Steel Wearing Parts
KECKLEY

TYPE PTM MODULATING PRESSURE-TEMPERATURE REGULATOR

Costs No More Than Less Sensitive Separate Units

The new Keckley Type PTM modulating pressure-temperature regulator establishes a new standard of accuracy of temperature regulation for batch processing, air ducts and other exacting control jobs. As temperature tends to vary, the thermostatic control unit acts upon the pressure regulator to reduce or increase steam pressure. Pressure will modulate smoothly and rapidly between the initial setting and zero, thereby preventing overrun. Rate of pressure modulation is adjustable, giving the user a wide choice of control.

This new valve costs no more than separate Pressure and Temperature Regulators but gives much finer control and a simpler installation. Originally developed to meet exacting TVA specifications, Type PTM is a refinement upon earlier Keckley types, which are still catalogued for average requirements.

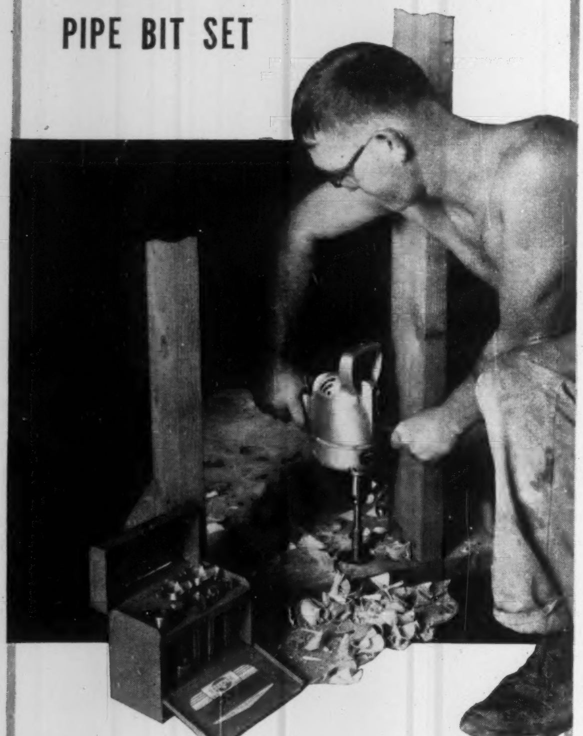
Ask for your copy of the new Catalog 54-F describing the complete Keckley line of Steam and Liquid Control Equipment.

O. C. KECKLEY COMPANY
400 W. MADISON ST.
CHICAGO 6, ILLINOIS

KECKLEY CHICAGO

Pressure Regulators • Temperature Regulators • Float Valves
Diaphragm Valves • Safety and Relief Valves • Solenoid Valves

QUICKLY BORE PIPE-SIZE HOLES IN WOOD WITH GREENLEE PIPE BIT SET



Make swift, easy work of an otherwise tedious, hard job. Quickly cut clean "tailor-made" openings for ½" to 2" pipe with the GREENLEE No. 1440 Pipe Bit Set. It is designed especially for plumbers, steamfitters, and electricians to provide fast, easy boring of *smooth* holes in wood — studding, floors, joists, etc. Bits are precision made and of highest quality for long life and clean, speedy boring. Made with ½" shanks with 3 flats for use in portable electric or pneumatic drills and in stationary boring machines. An adapter is provided in the set for using the bits with standard auger-bit braces. Set also includes electric drill adapter and coupling for using standard ⅜" pipe as an extension for deeper boring and longer reach. Set contains six bits for boring holes to accommodate the following pipe sizes: ½", ¾", 1", 1¼", 1½", 2". Bits, adapters, and coupling packed in an attractive, sturdy metal box with convenient carrying handle. Write today for descriptive folder.

TOOLS FOR CRAFTSMEN
GREENLEE

Greenlee timesaving tools for plumbing and heating work: Hydraulic Pipe Pushers • Hydraulic Pipe Benders • Tubing Benders • Pipe Bits Auger Bits • Spiral Screw Drivers • Chisels • And many more Greenlee Tool Co., 2351 Twelfth Street, Rockford, Illinois.

RECENT TRADE LITERATURE

Continued

Aluminum Conversion Guide

Handy wall chart shows the new designation system for wrought aluminum and wrought aluminum alloys. The new four digit system, developed by the Aluminum Association, became effective this month. The guide indicates old and new designations in easy to read bold type and has been designed as a permanent reference. It may be used either as a wall chart, or punched for use in a three-ring binder.

Manufacturer—Kaiser Aluminum & Chemical Sales, Inc., Industrial Service Div., 1924 Broadway, Oakland 12, Calif.

Automatic Controls

For heating, air conditioning and appliances. New 28 page catalog incorporates many new products, improvements and designs. Handy product information and how-to-select data are provided.

Manufacturer—The Perfex Corp., Advertising Dept., 500 W. Oklahoma Ave., Milwaukee 7.

Brass Valves

A complete brass valve catalog is available to heating and piping contractors. Each valve is completely described with standard sizes listed and service recommendations. Catalog sections include: radiator valves and elbows for steam and gravity hot water heating systems; circulator valves, balancing elbows and fittings for forced hot water heating systems; globe, angle and drainable globe stop valves; boiler drain and sill faucets; gate and check valves for iron pipe and copper tubing; roughing-in dimensions; and heavy-duty valves.

Manufacturer—The Hammond Brass Works, Hammond, Ind.

Air Conditioning — in French

A 15 page illustrated booklet in French. Provides technical data on air conditioning load determination and system design. Presented are a precise method of load calculation and a simplified method and sample cases of each. Also, a calculation sheet, instructions on choice, size and placement of ducts and grilles, location of equipment and return air handling. A variety of charts, diagrams and graphs.

Manufacturer—The United States Air Conditioning Corp., Export Dept., 13 East 40th St., New York.

Suspended Direct Fired Heaters

Triple pass heat exchangers, oil or gas fired, capacities 90,000 to 450,000 Btu at bonnet, 950 to 5000 cfm. Described in two page circular with illustrations and specifications.

Manufacturer—The Universal Products Mfg. Corp., Auburn, Ind.

Package Boiler Controls

Specifications for the fully automatic, all electric metering type package control for shop assembled boiler are given in four page bulletin 54-1088-239. Schematic drawing shows a typical packaged control system for a combination oil and gas fired boiler.

Manufacturer—The Hays Corp., Michigan City, Ind.

Electronic Controls

A new booklet on the installation of "Electronic Moduflow" electronic temperature control system. The 16 page handbook Y216 A includes a general description of the electronic system and a discussion of its components. Installation suggestions, wiring diagrams and calibration instructions are also included.

Manufacturer—The Minneapolis-Honeywell Regulator Co., Wayne and Windrim Avenues, Philadelphia 44.

Electric Motors

A new multi-color booklet, No. 1878, illustrating 20 types of improved motors is available. Natural color pictures illustrate the following types: uniclosed, totally-enclosed, explosion proof with and without fan, varidrive, syncrogear, combination variable speed and internally geared units, right-angle worm gear, verticlosed hollowshaft, vertical solid shaft, test stands and aircraft.

Manufacturer—U. S. Electrical Motors Inc., Box 2058, Los Angeles 54.

Pipe Covering Protector

"Protektinsul" pipe covering protector, a prefabricated, poly-vinyl chloride outer finish designed to protect insulation against weather, abrasion, chemicals, mildew, etc., is described in bulletin No. 7. All physical, electrical, and chemical properties are listed. The finish is furnished to exact size, requiring no cutting, fitting or sewing in the field, according to the bulletin.

Manufacturer—Miracle Adesives Corp., 214 E. 53rd St., New York 22.

Miniature Time Delay Relays

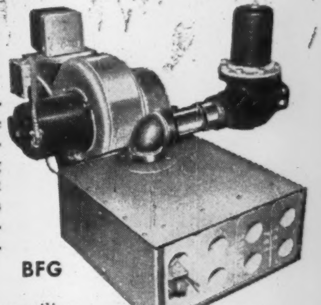
A revised bulletin of miniature hermetically-sealed relays for either A-C or D-C units. Time delay settings are available from two seconds to three hours. Bulletin gives design features and mentions detail characteristics and factors which might determine type of timer to be used.

Manufacturer—The A. W. Haydon Co., 230 North Elm St., Waterbury, Conn.

Why So Many Heating Engineers SPECIFY

Power-Flame BURNERS

You'll find a Power-Flame Burner engineered to insure peak efficiency for EVERY Commercial, Industrial or Domestic Application.

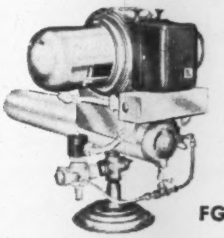


Regardless of application, whether it be straight gas or combination gas-oil, heating engineers know that Power-Flame burners supply fuel-saving, easy-to-install, high-efficiency heating.

BFG

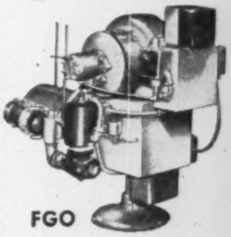
Every Power-Flame burner utilizes quiet, amply-sized blowers which provide balanced air mixture, eliminating the effects of natural draft conditions, and thus, providing metered air for complete combustion and highest heating plant efficiencies even in down-draft boilers or furnaces.

BFG Series (pictured above), 8 models in capacities from 450,000 BTU to 9,000,000 BTU input. With these features... factory wired—controls and valves mounted...wired sequencing panel provide purge period for utmost safety...positive control of air for combustion...dollar for dollar, the industry's best buy.



FG

FG Series 3 gun type units—Model FG 175, capacity 175,000 BTU, AGA listed; Model FG 330, capacity 330,000 BTU, AGA listed; model FG 500, 500,000 BTU. Ideal for replacement of oil burner... serves a wide range of hard-to-fire applications.



FGO

FGO Series—Combination Gas-Oil—6 models in capacity to 3,500,000 BTU input. Features include... automatic ignition for BOTH fuels... automatic air adjustment... electronic safeguard ...factory assembled and tested for both gas and oil. Automatic or manual changeover optional.

A Power-Flame dealership can be valuable. Write today for complete information.

Siemon Power-Flame BURNER

Manufacturing Co.

1819 HOLMES DEPT. HP KANSAS CITY, MO.

RECENT TRADE LITERATURE *Continued*

Space Heaters

Bulletin No. 552 describes a line of "Paraflo" warm air, oil or gas fired space heaters designed for commercial and industrial establishments. The eight page booklet illustrates design and construction features, shows application and installation information and gives engineering data on these 200,000 or 250,000 Btu per hr capacity heaters.

Manufacturer—The Dravo Corp., 1203 Dravo Building, Pittsburgh 22.

Pressure Reducing Valves

Designed especially for the heating, ventilating, air conditioning industry, new 12-page bulletin, C-89, gives complete specifications of a line of lever and float valves and strainers. Detailed information includes application data, features, sizes, capacity tables, operation and installation drawings.

Manufacturer—The Fisher Governor Co., Marshalltown, Iowa.

Submersible Turbine Pumps

Described in four page bulletin 6710-20, with photo cut-away illustrations and ink drawings, and tabulated specifications.

Manufacturer—The Deming Co., Salem, Ohio.

Shock and Vibration Control

Shock and Vibration Control Notes, new four page quarterly technical publication. First issue has a report on "Shock Mounts as Means of Increasing Validity of Shock Tests."

Manufacturer—The Barry Corp., Watertown, Mass.

Self-Contained Boilers

Recently announced line of small boilers is described in new four page bulletin, AD-135. Boilers are available in 50 to 80 hp — 15 to 150 lb steam, 30 lb hot water — for heating and processing. Major advantages are silent operation, fuel flexibility, fast, easy maintenance, automatic safe operation, states the manufacturer.

Manufacturer—The Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee 12.

Wire Mesh Demisters

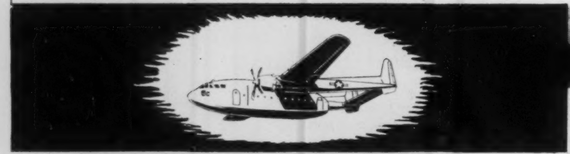
A four page illustrated bulletin describing wire mesh sections designed to improve performance and increase the throughput capacity of process vessels handling both liquid and vapor phase materials contains technical information and describes how manufacturer's product effects separation between vapor and liquid at high vapor velocities.

Manufacturer—Otto H. York Co., Inc., 6 Central Ave., West Orange, N. J.

FAIRCHILD AIRCRAFT USES

TRADE FRICK MARK

Air Conditioning



Frick Company recently completed the engineering and installation of a year 'round comfort air conditioning system for the new office annex of the Fairchild Aircraft plant in Hagerstown, Md., where they manufacture their famous C-119 Flying Boxcars.

The cooling load of 245 tons of refrigeration is carried by two Frick "ECLIPSE" 9-cylinder high-speed compressors.

For the latest in air conditioning and refrigeration engineering and equipment, look to Frick Company, now in its second century of service to business and industry.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK Co.
WAYNESBORO, PENNA. U.S.A.

One of the new Fairchild offices and pair of Frick "ECLIPSE" compressors which provide comfort cooling.

WHO'S WHAT . . .

▶ *DUNCAN CAMERON MENZIES* has been elected president, general manager and a director of *SERVEL, INC.*, succeeding *W. PAUL JONES*, who becomes vice chairman of the board. Other appointments are *WILLIAM W. WALLACE* to the position of assistant vice president of the International Div., and *CARL V. CHURCH* as production superintendent of the room air conditioner division.

▶ *WILLIAM R. FUNK* was elected president of *DURANT INTERNATIONAL CORP.*, at a recent board of directors meeting. Mr. Funk will also continue as sales manager.

▶ *GUSTIN-BACON MFG. CO.*, has announced the appointment of *F. W. MULLER* as sales manager of a newly created pipe insulation line.

▶ *WILLIAM F. WOOD* has been promoted to the post of general sales manager of *THE RIC-WIL CO.*, replacing *C. W. WHEELER*, who is retiring. Mr. Wood was formerly district manager in the Washington, D.C. office.

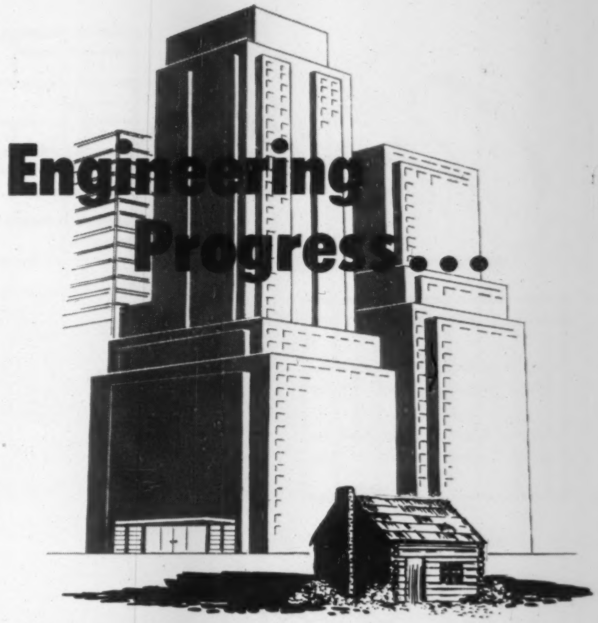
▶ *A. B. DRASTRUP* is the newly elected president of *A. M. BYERS CO.*, succeeding *L. F. RAINS*, who retired recently after 23 years as president and a director of the company. Mr. Drastrup joined the company in 1931 and, in February of this year, was named executive vice president.

▶ *KEITH T. DAVIS* has been assigned to the executive staff of *AFFILIATED GAS EQUIPMENT, INC.*, and will assume the title of technical director. Mr. Davis has been directing the engineering program of the Bryant Heater Div.

▶ *DETROIT CONTROLS CORP.* has appointed *FRANK A. PARKER* to the position of director of research and engineering. He was formerly research director of the company's research division in California.

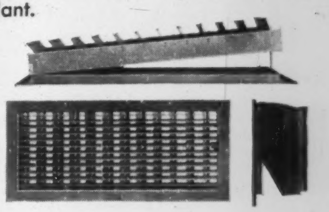
▶ *WILLIAM G. SHEPARD* has been appointed general sales manager for the *OHIO INJECTOR CO.* He will supervise domestic and foreign sales activities.

▶ *JOSEPH T. RYERSON & SON, INC.* has appointed *RAYMOND N. CARLEN* as assistant to the vice president in charge of operations. He formerly was assistant operating superintendent at the company's Chicago plant.



Your guarantee of Top Performance in Stewart REGISTERS and GRILLES

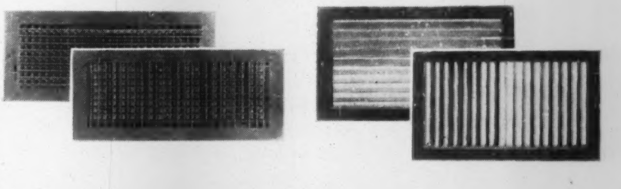
When you specify the Stewart line, you specify uniformly high quality, and dimensional accuracy in every air conditioning outlet manufactured in our plant.



Available in more than 50 styles and in 2100 sizes; all of which are not only pleasing to the eye, but also designed to strict engineering principles that provide every feature demanded by this fast growing market.

One of the outstanding features is the new opposed-action valve. This unit provides positive damper setting in any position and gives uniform air distribution over the entire face of the register.

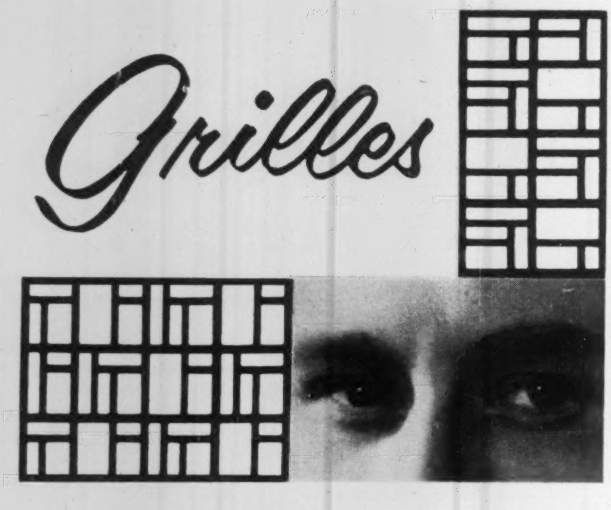
Your inquiries are solicited. Send for the new Catalog No. 54 showing our entire line and its many plus values.



Stewart MANUFACTURING CO., INC.
Grove Ave., Essex County, Cedar Grove, N. J.

Sales Representatives in the Principal Cities of United States.
Canadian Representative; AIR-CARE LTD., Montreal

Grilles



for that

distinctive look

Just as eye-appealing as they are functional, Hendrick Perforated Metal Grilles will greatly enhance the beauty of your decorative motif.

They provide more-than-ample open area for the free passage of air, and are available in a wide variety of designs to best set off your decor. And they're easy to install because of a special flattening operation in their manufacture.

Over one hundred basic designs are available to choose from — many are obtainable only from Hendrick. Hendrick will gladly cooperate with architects to help select from a wide range of standard and special designs. For more complete details write Hendrick today!

SEE OUR CATALOG IN SWEET'S

Hendrick
MANUFACTURING COMPANY

48 DUNDAFF ST., CARBONDALE, PA. • *Sales Offices in Principal Cities*
Perforated Metal • Perforated Metal Screens • Wedge-Slot Screens • Architectural Grilles • Mitco Open Steel Flooring • Shur-Site Treads • Armorgrids

WHO'S WHAT *Continued*

▶ *ALLEN OSTROGNAI* has been appointed research engineer by the *VIKING AIR CONDITIONING DIV., THE NATIONAL RADIATOR CO.* Mr. Ostrognai has had 10 years' experience as an engineer for General Electric Corp.

▶ *WALTER E. MAX* has been appointed general superintendent of the *WORTHINGTON CORP.* Buffalo works. Replacing Mr. Max in his former position as manager of the Buffalo service and erection department is *HARRY P. YOUNT*. *GEORGE L. ZIEGLER*, assistant manager of the Buffalo works, has been named manager of parts service for the corporation.

▶ *C. C. LOWRY* has joined *ZURN SERVICES, INC.*, New York, an affiliate of *J. A. ZURN MFG. CO.*, as vice president of sales. He will direct and control operation of the company's offices and distribution warehouses.

▶ *AIRTEMP DIV., CHRYSLER CORP.*, has named *JOSEPH D. LOVELEY* vice president in charge of engineering. Mr. Loveley joined the company in 1935.

▶ *LAWRENCE F. HOGAN* has been named product specialist for transportation equipment for *CARRIER CORP's*. Machinery and Systems Div.

▶ *J. WALTER GULLIKSEN* is the newly appointed general manager of the *WATERBURY MFG. CO.*, Div. of *CHASE BRASS & COPPER CO.* He will be in charge of production.

▶ Stockholders of *THE DOLE VALVE CO.* recently elected *THOMAS B. CHACE* and *ROBERT M. ELLIS* to be directors of the corporation. Both of the new directors have served as vice presidents since 1941 and will continue in their respective duties.

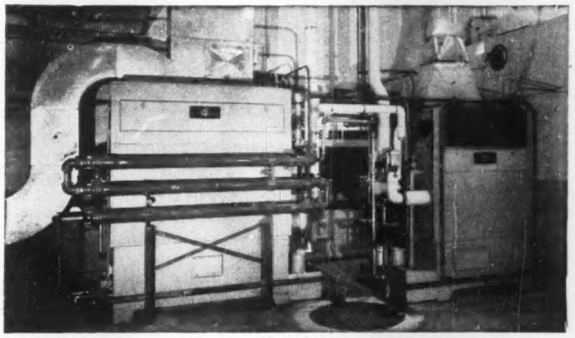
▶ *UNISTRUT PRODUCTS CO.* has appointed *RALPH R. BUTLER* to the post of executive vice president. The company's growth has prompted the creation of this new post.

▶ *FRANCIS A. DEVIN*, partner in the law firm of Phillips & Avery, New York, has been elected a director of *UNITED STATES AIR CONDITIONING CORP.*

▶ The *COPPER & BRASS RESEARCH ASSN.* has added *WESLEY S. THURSTON* to its advertising and promotion staff as part of its recently launched expanded promotion program. Mr. Thurston was formerly assistant publicity director at the Glenn L. Martin Co.

This NEW METHOD DRIES AIR

PRECISELY AS YOU WANT IT



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

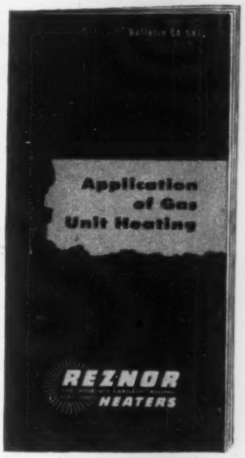
Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

For complete information write

NIAGARA BLOWER COMPANY
Over 35 Years of Service in Industrial Air Engineering
Dept. HP, 405 Lexington Ave. New York 17, N. Y.
Sales Engineers in Principal Cities of U. S. and Canada

the where when why how of gas unit heater applications



Application of Gas Unit Heating

REZNOR HEATERS

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What Is A Unit Heater
How Gas Unit Heaters Cut Heating Costs
When to Use Gas Unit Heaters
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Selecting the Right Heaters
Optional Equipment
Reznor Heater Features, Construction Details and Specifications
Unit Heater Coverage
Unit Heater Location
Temperature Controls
Venting
Computing Gas Line Requirements

compiled for you by the manufacturer of the world's largest-selling gas unit heater

Send for your free copy today

REZNOR
THE WORLD'S LARGEST-SELLING GAS UNIT HEATERS

REZNOR MANUFACTURING COMPANY
51 UNION ST., MERCER, PA.

Please send me a copy of your new bulletin, "Application of Gas Unit Heating."

Name____________ Title________
Company____________
Street____________
City________ Zone____ State______

WHO'S WHAT

Continued

▶ *PITTSBURGH PLATE GLASS CO.* has named *MICHAEL J. BATENBURG* director of information services, *RICHARD W. DITTMER* manager of public relations and *NORMAN L. PARK* manager of publications.

▶ With expansion of company operations, *THE O. A. SUTTON CORP.* has promoted several executives to new positions. *EARL H. RENFRO* has been named assistant general sales manager, *FRED KATHS* has become sales manager of the Consumer Appliance Div., *WES BRIENT* is sales manager of the Commercial Products Div., and *FRED RICKETTS* has filled Mr. Kath's former position as advertising manager.

▶ *PETER VOGEL* has been elected vice president of *MIRACLE ADHESIVES CORP.*, and manager of West Coast operations. For the past two years, Mr. Vogel has been western district sales manager.

▶ The *A. O. SMITH CORP.* has named *C. L. HEWITT, JR.*, as manager of heating and air conditioning sales for its "Permaglas" Div., and *F. A. HENRY* has been appointed general manager of the corporation's Pacific Coast works.

▶ Promotions at *KOBE, INC.*, are *W. F. SLATER* to general sales manager, *R. G. RALPH* to hydraulic service manager, *RAY ELNER* to hydraulic sales manager and *J. T. LEWIS* southern division sales manager.

▶ *ALLEN H. WHITEHEAD* has been appointed manager of *METAL GOODS CORP's.* Nickel and Nickel Alloy Div. He will direct sales, give technical guidance, and work as a liaison between the International Nickel Co., the Metal Goods Corp. representatives, and consumers of nickel and nickel alloys.

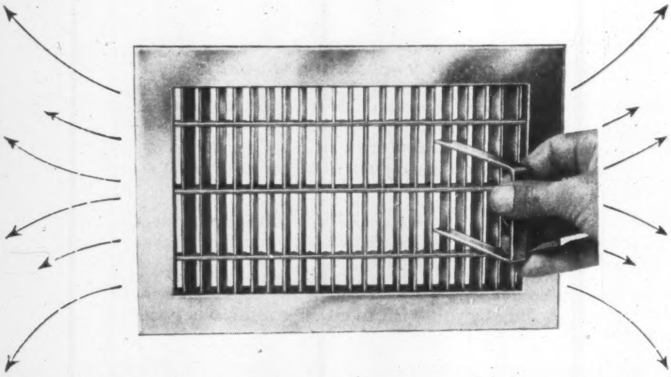
▶ *JOHN J. NESBITT, INC.*, has named *RICHARD B. SWEET* as sales manager of its Wholesale Div. *MICHAEL J. MURRAY*, who until recently held this position, will now take on the sales management of another of the company's heating and ventilating products.

▶ Appointments of *HAROLD WRIGLEY* as works manager and *CHARLES S. BASNEY* as new products manager have been made by the *BARRY CORP.* Mr. Wrigley joined the company in 1951 as plant superintendent. Mr. Basney came to the engineering department in 1946, doing development work.

▶ *PETER A. ARGENTIERI* has been named sales manager of the *DOREX DIV., CONNOR ENGINEERING CORP.*

where you want the best

in SCHOOLS
in HOSPITALS
in PUBLIC BUILDINGS



SPECIFY THE SOLID BAR TYPE GRILLE & REGISTER

- Constructed of sturdy 14 gauge steel bars.
- Interlocking Cross Bars for Added Strength.
- Fixed Bars, single or double deflection.
- Tamperproof and Kickproof — Built to withstand abuse.

Solid 14 gauge Bars make the Grilles and Registers rugged and long lasting. Their interlocking construction makes them Tamper-proof — adjustable only with special tool provided with each order. Where you want the best in construction and performance — there is no other choice. It's R & G all the way!

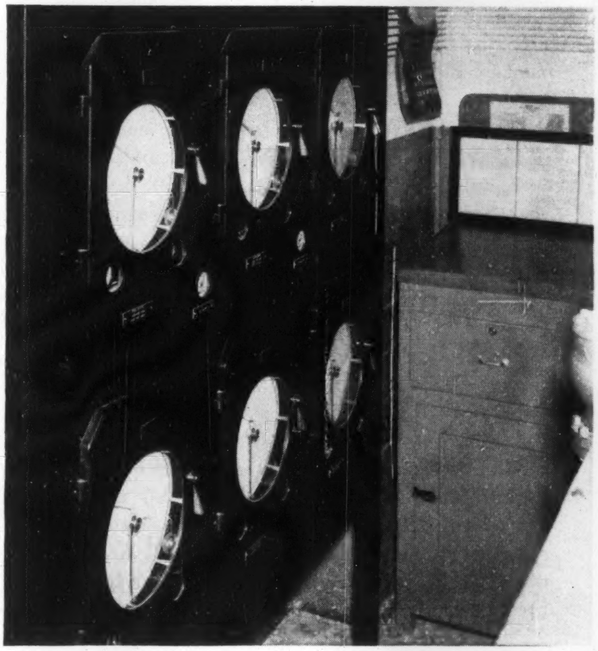
Complete Line of Registers and Grilles for
HEATING VENTILATING AIR CONDITIONING

FREE
Catalog
on Request

Specify and Install **R & G** REGISTERS and GRILLES

REGISTER & GRILLE MFG. CO., INC.
70 BERRY STREET, BROOKLYN 11, N. Y.

HOW TO POLISH YOUR BRASS



Air conditioning controls for the executive offices of a well-known Mid-Western Corporation.

KEEP your executive offices cool and clean the year round with the help of Taylor Automatic Dew Point Control. This is the most direct temperature and humidity control system available. The air conditioning job can be handled by any good engineering contractor. But be sure to tell him you want Taylor air conditioning instrumentation. A Taylor Application Engineer will work with him in laying out the system and making final adjustments.

This highly versatile Taylor Automatic Dew Point Control System uses:

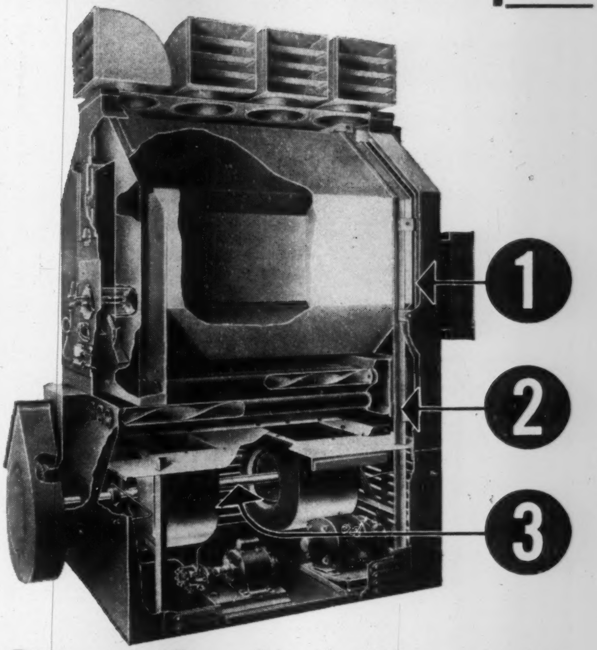
1. Dry Bulb Controller for pre-heating outside air to a constant temperature.
2. Wet-and-Dry Bulb Controller applied to air washer for dew point and humidity control.
3. A summer-winter changeover controller for positioning dampers.
4. A Type-P Expansion-Steam Controller for protection against spray water freezeup.

Ask your Taylor Field Engineer for details of Taylor controls for air conditioning systems—for human comfort—or for product quality. Or write for **Catalog 5.** Taylor Instrument Companies, Rochester, N. Y.; Toronto, Canada.

Taylor Instruments
MEAN ACCURACY FIRST

---

another DRAVO HEATER plus



Strength where it counts

1. **Heavy-gauge double outer casing** gives double strength . . . air space between provides better insulation, cuts radiation loss to less than 1%.

2. **Heavy duty structural steel framework** gives more strength to heater . . . permits safe wall-mounting or suspension from ceiling to save floor space.

3. **Strong large-diameter fan shaft** carries all air supply fans and exhauster . . . reduces number of working parts . . . adds extra life to heaters.

Dravo Heaters are ruggedly constructed . . . and have *extra strength where it counts.* This extra strength, another Dravo Heater PLUS, is your assurance of longer heater life, economical operation, and flexibility of installation.

Mail the coupon for complete information

DRAVO CORPORATION, Heating Department
Fifth and Liberty Avenues, Pittsburgh 22, Penna.

Please send me complete information about the Dravo:

☐ *Counterflo* Space Heater ☐ *Paraflo* Space Heater ☐ *Gas Fired* Unit Heater

☐ Please have a representative call at no obligation to me.
☐ Ask for Bulletin IJ 598-8901.

Name__________ Title__________
Company__________
Address__________
City__________ Zone_____ State_____

ANOTHER d-h "PLUS!"

"HOT DIP" Galvanizing

AFTER FABRICATION ON ALL

PERMA-FAN

EVAPORATIVE CONDENSERS

A NEW D-H JOB:
Edison Company business offices, Ontario, California
PF-304

Installation by Key Refrigeration, Los Angeles.

IT'S SERVICE-FREE PERFORMANCE with Perma-Fans—ever since D-H pioneered the blow-thru principle of operation, back in 1937!

NOW, new and proven advances give you an expanded Perma-Fan line:

- In tonnage ratings from 5 to 105
- For indoor or outdoor installation
- Choice of refrigerants: Freon, Ammonia
- "Hot Dip" galvanizing on ALL surfaces

Particulars? Request Catalog PF C-3.30.

d-h SINCE 1910

drayer-hanson
INCORPORATED
3301 MEDFORD STREET, LOS ANGELES 63, CALIFORNIA
(A Subsidiary of United States Radiator Corporation)

WHO'S WHAT

Continued

▶ *WILLIAM K. BODY* has been named assistant chief engineer in charge of refrigeration and air conditioning of *THERMADOR ELECTRICAL MFG. CO.*

▶ *J. B. BLANTON* has been appointed general sales manager of *STODDARD INDUSTRIES, INC.*

▶ The *TORRINGTON MFG. CO.* has named *WILLIAM E. CASHEN* to fill the new post of sales engineer. Rapid growth of the industry within the past few years was cited as the reason for the creation of the post by *DUDLEY B. ROBINSON*, vice president.

▶ New manager of *TRION, INC's.* Special Products Div. is *LUTHER C. CAMPBELL, JR.* His duties will consist of development of special projects in which air cleaner equipment will be used, particularly by the Dept. of Defense.

▶ With reorganization and expansion of its local sales staff, *TYPHOON AIR CONDITIONING CO., INC.*, has added *MAURICE FIRESTONE* to head the new sales group and *MELVIN KLINGHER* to serve as district sales manager for northern New Jersey and Staten Island.

▶ *BONNEY FORGE & TOOL WORKS* has appointed *WARREN J. SCHOLL* as advertising and merchandising manager. Mr. Scholl formerly handled sales promotion for a Canadian automotive wholesale distributor.

IN THE TERRITORIES . . .

▶ For *UNION ASBESTOS & RUBBER CO.—JACK THOMAS DAVIS*, 3303 Montrose Blvd., Houston, as sales representative handling heating and air conditioning equipment in a territory comprising southeastern Texas and the Gulf Coast.

▶ For *DeBOTHEZAT FANS DIV., AMERICAN MACHINE AND METALS, INC.—THE J. W. CHERRY CO.* as sales representative to cover northern Louisiana and eastern Texas, handling industrial ventilating and air moving equipment. Offices are at 150 Olive St., Shreveport.

▶ For *ANEMOSTAT CORP. OF AMERICA—ZINTEL-DEVITT CO.*, 840 N. Michigan Ave., Chicago 11, as exclusive representative in metropolitan Chicago, central and northern Illinois, and northern Indiana.

▶ For *THE COOPER ALLOY CORP.—ROBERT LEE WEIDMAN* as technical sales representative in the mid-Atlantic states.

What will it do for ME? COMPARE IT and SEE!

POINT by POINT this new American-Marsh CONDENSATE RETURN UNIT gives more for your money!

Compare —

FLOATLESS ELECTRODE CONTROL — Top-quality, non-corrodible stainless steel rods and tips control pump. No moving parts, no float to stick or waterlog. More accurate control — trouble free for years!

EASY TO INSTALL — Above, on or in pit below floor. Just hook up piping and cable.

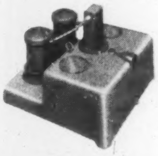
TOP-QUALITY PUMP — Balanced bronze impeller, mechanical seal, requires no lubrication. Quiet-running, tremendously dependable. Impeller removable without disturbing piping. Backed by 81 years' pump building know-how!

LARGER RECEIVER TANK — Lifetime cast iron, 16 gallon capacity. Low return inlet.

SINGLE OR 3-PHASE MOTORS — To suit your current. Drip-proof, ball-bearing design, high quality.

RANGE OF SIZES, TYPES — Single or duplex — order to suit your job! *Size 1* — to 5,000 sq. ft. EDR at 20 lbs. disch. pressure — 18,000 sq. ft. at 8 lbs. *Size 2* — to 9,000 sq. ft. EDR at 30 lbs., 18,000 sq. ft. at 20 lbs.

Compare THIS UNIT — for *permanent* satisfaction in school, store, hotel, office and apartment heating systems. Then —



DUPLEX UNIT

WRITE FOR COMPLETE DATA NOW! REQUEST BULLETIN CRU

AMERICAN-MARSH PUMPS

BATTLE CREEK MICHIGAN

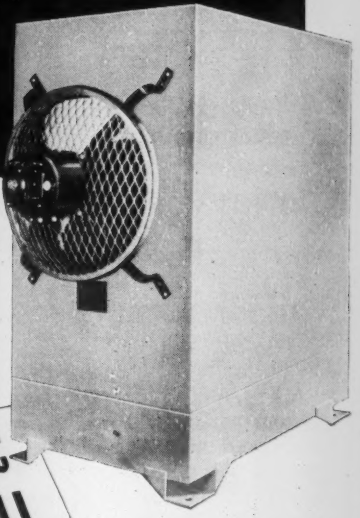
In Canada:
American-Marsh Pumps (Canada) Ltd., Stratford, Ont.

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, FIRE PROTECTION, ETC

COOLING TOWER

by

KRAMER



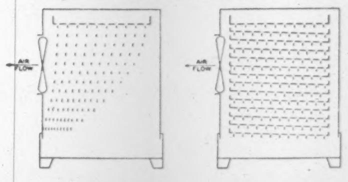
3 to 8 Ton

SCIENTIFIC NEW FILL

MORE CAPACITY
The redistributing decks keep the water uniformly suspended, providing maximum contact between air and water.

LONG LIFE
Casing and sump are heavy gauge steel, hot dipped galvanized after fabrication. Redistributing decks are metal and fireproof.

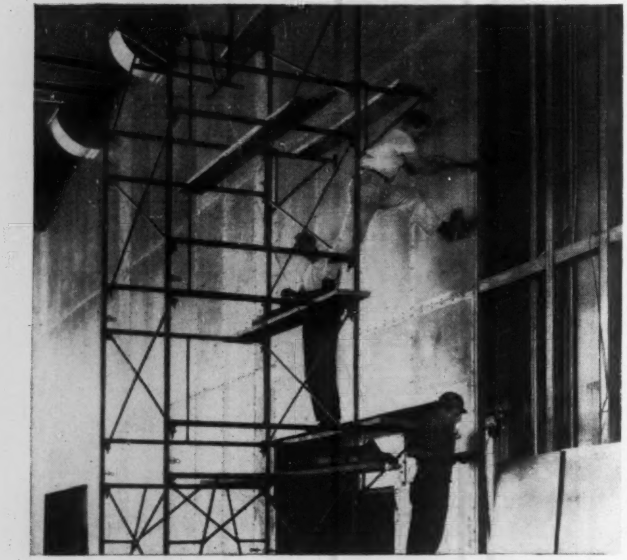
EASY INSTALLATION
Unit is shipped assembled but can be knocked down to eliminate rigging costs. One fitting required for drain and over-flow.



Conventional Fill   Kramer Fill

Write for Catalog R-225

KRAMER TRENTON CO.
Trenton 5, N.J.



Saves 75% of fastening time by anchoring sheet steel wall with fast, easy Ramset system

About 20,000 individual fastenings were needed to anchor 4′ x 8′ 12-gauge perforated steel sheets to steel beams, to wall the paint hangar at the recently completed airplane plant of North American Aviation Corporation, Columbus, Ohio. The wall is required to permit adequate ventilation of 47,250 square feet of space, with a change of air every three minutes from air intakes and exhausts located on opposite sides.

Using RAMSET JOBMASTER fastening tools and Tru-Set drive pins, fastenings were made at a rate better than 50 per hour per man, or 1,200 per day for a three-man crew. This was at least 4 times faster than old-fashioned, conventional methods of drilling and setting studs in the beams. Not only was the work completed far sooner, but a substantial cost-reduction was realized.

Similarly, RAMSET SYSTEM saves money and time on almost any job of fastening to steel or concrete for maintenance, modernization or new construction. Anchoring can be done in split seconds into the hardest concrete, or into mild steel up to 1″ thick, with the proper selection of tools, fasteners and power charges from the versatile RAMSET line.

Ask your RAMSET dealer how you can profitably apply RAMSET SYSTEM to your own work, or write us for details and *Specification Manual.*

Ramset Fasteners, INC. RAMSET DIVISION, OLIN INDUSTRIES, INC.
12109 BEREA ROAD • CLEVELAND 11, OHIO

FIRST IN POWDER ACTUATED FASTENING AN Olin PRODUCT

WHO'S WHAT

Continued

▶ For *GLASS FIBERS INC.*—Five regional sales managers: *S. AUSTIN MARQUIS* as Detroit regional manager, supervising sales in Michigan, Ohio, Indiana and Kentucky; *EDWARD A. McCABE* as New York manager, with headquarters at 161 E. 42nd St., to supervise sales in eastern New York, northern New Jersey, Delaware, eastern Maryland and all of the New England states; *JOHN B. BANKS* as manager at Philadelphia, supervising sales in Pennsylvania, western New York, West Virginia and southeastern Ohio; *ROBERT E. SIMPSON* in Atlanta, supervising the Georgia, Florida, Carolinas, Virginia, eastern Tennessee, Alabama, Mississippi, Louisiana, Oklahoma and Texas territory; and *KEN C. SETTELMYER* in Chicago, supervising sales in Illinois, Wisconsin, Minnesota, Iowa, Missouri, Arkansas, western Tennessee, Kansas, Nebraska, North Dakota, South Dakota and upper Michigan.

▶ For *ELECTRO DYNAMIC DIV., GENERAL DYNAMICS CORP.*—*ALLAN B. COLLINS* as district manager of the Kansas City, Mo., area. *JAMES A. SETCHELL CO.* has been named to handle the sale and service of the company's motors and generators in the state of Arizona.

▶ For *FLEXIBLE TUBING CORP.*—*PHILIP H. MARSH* as manager, western operations, to direct West Coast sales from Pasadena. He will be responsible for the proposed warehouse and assembly operations as well as supervision of sales in California, Oregon, Washington, Idaho, Montana, Wyoming, Nevada, Arizona, New Mexico, Colorado and Utah.

▶ For *THE RIDGE TOOL CO.*—*CARL PETERSEN* as exclusive factory representative in Illinois, to succeed *EVERETT C. BLISS,* who retired recently after 25 years of service with the company. Mr. Petersen will handle "Ridgid" pipe tools. The new representative in Michigan and Indiana is *MILO SHARP* and in North and South Dakota, Wisconsin and the upper Michigan peninsula, *WALTER R. MILLER.* Mr. Sharp and Mr. Miller also succeed Mr. Bliss, taking over parts of his former territory.

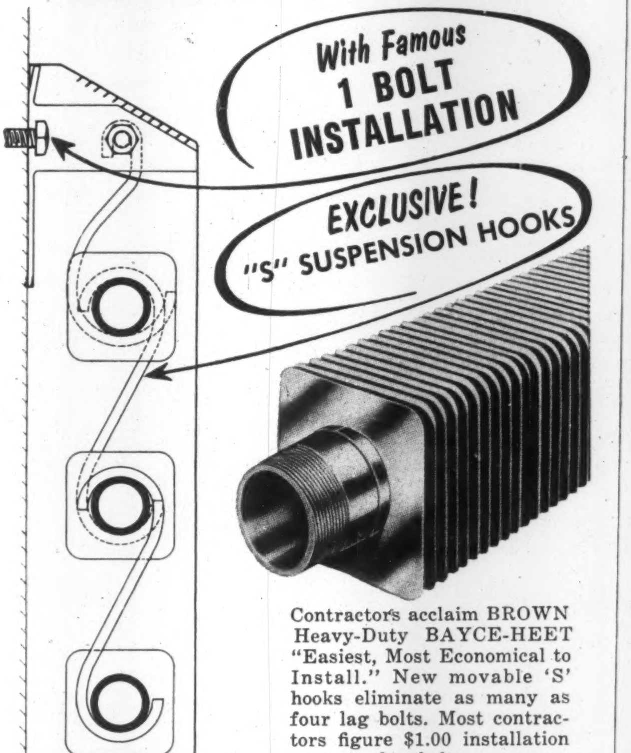
▶ For *CHELSEA FAN & BLOWER CO., INC.*—*GEORGE C. BLEW* as representative in Kansas City, Mo., to cover Kansas, Nebraska, Oklahoma, northern Texas, western Missouri and Ft. Smith, Ark. Formerly he was service manager at the company's home office.

▶ For *DRAVO CORP.*—*WILLIAM E. BAILEY* as Chicago industrial area representative for the application and sale of industrial air conditioning equipment. He has been with the company for 12 years.

EASIEST MOST ECONOMICAL TO INSTALL

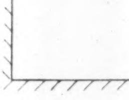
I-B-R
Reg. U.S. Pat. Off.

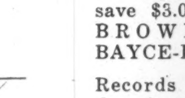
BROWN BAYCE HEAVY-DUTY HEET

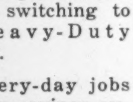


Contractors acclaim BROWN Heavy-Duty BAYCE-HEET "Easiest, Most Economical to Install." New movable 'S' hooks eliminate as many as four lag bolts. Most contractors figure $1.00 installation cost per lag bolt . . . save a lag bolt and you save a dollar. If the fintube you now use requires 4 lag bolts, you save $3.00 by switching to BROWN Heavy-Duty BAYCE-HEET.

Records of every-day jobs show installation savings averaging 10% with BROWN Heavy-Duty BAYCE-HEET.


BROWN-HEET CONVECTOR UNITS

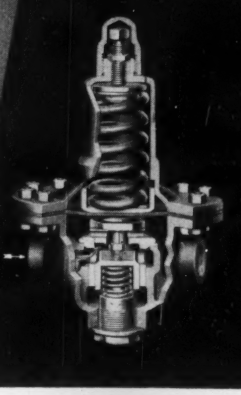

BROWN BAYCE-HEET


BROWN AIR CONDITIONER

Write for our I.B.R. Catalog Ratings in Bulletin 300-1

BROWN PRODUCTS COMPANY
FOREST HILLS, NEW YORK

If it's... McALEAR equipped it's under SAFE control



One of the many McAlear Controls—No. 258 Pressure Reducing Valve compactly designed for service requiring a tight shut-off and is in widespread use for controlling air, gas and steam pressures.

● There's one thing you can be sure of in McAlear Controls and that's dependability . . for infinite care and engineering exactness guard every step of McAlear manufacturing. And before a McAlear control is shipped for sale or use it is job tested for performance. That's why we say—"If it's McAlear Equipped it's under SAFE control." Write for descriptive literature today.

FOR EVERY CONTROL NEED
REMEMBER McALEAR

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL-GAS

McALEAR MANUFACTURING COMPANY
1901-1919 South Western Avenue
Chicago 8, Illinois

WE HEAR THAT . . .

▶ *YORK CORP.* has announced the opening of central district sales and engineering offices in Chicago with *JOHN J. FLORETH* as district manager. The construction and service phases of the Chicago operation will continue to be handled by *WESTERLIN AND CAMPBELL CO.*, a wholly-owned subsidiary, which has served the parent company since 1906. Mr. Floreth was also elected president of Westerlin and Campbell Co., succeeding *F. T. BRANDT*, who has retired.

The establishing of this new office is part of a realignment of the company's organization, both at its headquarters in York, Pa., and in the field. This new plan sets up three self contained divisions — industrial, commercial and international — responsible to the president, *STEWART LAUER*. These divisions are headed by *R. K. SERFASS*, *J. K. LOUDEN* and *C. B. MORRISON* respectively.

▶ The *DURO-DYNE CORP.*, New Hyde Park, N. Y., announces its purchase from *PARKER KALON DIV.*, *GENERAL AMERICAN TRANSPORTATION CORP.*, of the complete line of damper quadrants, regulator accessories, metal punches and "Shur-Grip" file and solder iron handles. All machinery and tooling have been moved to the Duro-Dyne plant; production will begin immediately. Duro-Dyne reports that there is to be no change in names, appearance, materials, design or workmanship of these products. This line will be manufactured in addition to other products in the air conditioning, heating and ventilating fields.

▶ *H. W. HEISTERKAMP* and *R. J. deFASSELLE*, the two principals in the consulting engineering firm of Spengler Associates, are now doing business under the firm name of *HEISTERKAMP & de FASSELLE*, P. O. Box 98, Cleveland 21, Ohio.

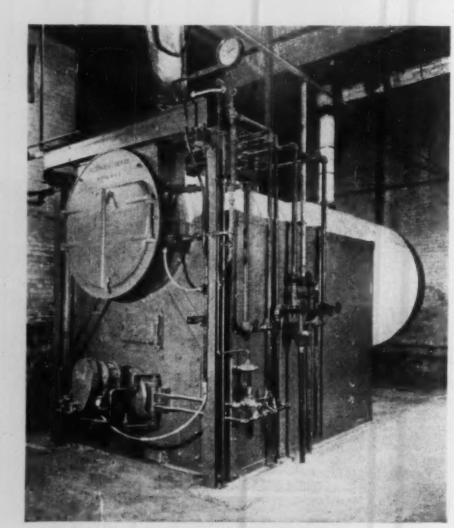
▶ *PHILLIPS, GETSCHOW CO.*, Chicago, heating, piping and air conditioning contractor, recently celebrated its 60th year in business with cocktails and a buffet dinner. The affair was attended by engineers, architects and other contractors and suppliers. *ROY M. GETSCHOW*, a former president of the Heating, Piping and Air Conditioning Contractors National Assn., became president and treasurer of the company in 1935, following the death of his father, *GEORGE M. GETSCHOW*, who, with *GEORGE J. PHILLIPS*, had founded the company in 1894.

Contracts have called for the heating and ventilating of many of the better known office buildings, hotels and theaters in Chicago, Detroit and Buffalo. Industrial and power plants, hospitals, apartment buildings, schools, churches, etc., have been other installations.

FARRAR & TREFTS, Inc.

ESTABLISHED 1863

20 Milburn Street
Buffalo 12, New York



BISON TWO-PASS BOILER

Streamline Welded BISON BOILERS Streamline Welded

FOR HEAT and POWER

Designed to produce maximum steam output in shortest time at minimum operating costs.

- Scotch Wet Back Package Unit Boilers
- Horizontal Return Tubular Boilers
- Locomotive Type Boilers
- Bison Two-Pass Refractory Lined Boilers
- Scotch Marine Boilers
- Scotch Dry Back Power Boilers
- Utility Scotch Boilers
- Bison Compact Boilers
- Bison Firebox Boilers

ASME — API-ASME — LLOYDS
QUALITY BOILERS TO GIVE QUALITY SERVICE

Step up

SPEED

THREADING ½" to 4" PIPE

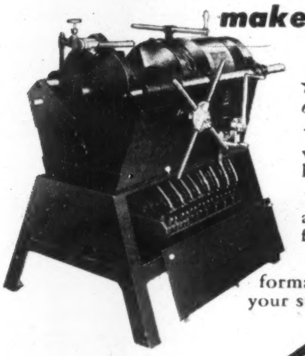
Bring down Costs!

This TOLEDO No. 1-2-4 maintains high production in pipe shop at DeVilbiss Co., Toledo, Ohio.

TOLEDO No. 1-2-4

POWER PIPE MACHINE

makes the job Easier!



★ *Threads 2" pipe in 18 seconds,* 3" in 30, 4" in 42.

★ *Cuts off 4" pipe in 9 seconds* with 4 high speed steel cutter knives, scroll fed.

★ *Instant size change* . . . separate quick-opening die head for each size pipe.

★ *High production* . . . performance proved! Order through your supply house.

Builders of World's Finest PIPE TOOLS . . . PIPE WRENCHES . . . POWER DRIVES . . . POWER PIPE MACHINES

TOLEDO

TOLEDO PIPE THREADING MACHINE CO.,
Toledo, Ohio

BLACKMER ROTARY PUMPS

ARE HANDLING THESE LIQUIDS AND SEMI-SOLIDS EFFICIENTLY AND ECONOMICALLY

- Acids
- Acetates
- Alcohols
- Ammonia
- Beer
- Bilge Water
- Black Liquor
- Bleaches
- Brewery Slop
- Brines
- Catsup
- Caustics
- Coal Tar
- Cream Corn
- Creosote
- Dog Food
- Dyes
- Enamels
- Fish Juices
- Fuel Oils
- Gasoline
- Glucose
- Glue
- Glycerine
- Grape Juice
- Kerosene
- Lacquers
- Lard (hot)
- Mash
- Mayonnaise
- Milk
- Mineral Oil
- Molasses
- Oils —
  - Cooking
  - Crude
  - Lube
  - Palm
  - Vegetable
- Naptha
- Paints
- Paraffin
- Printing Ink
- Rubber Cement
- Salad Dressing
- Shellac
- Silicate of Soda
- Sizings
- Soaps
- Solvents
- Soups
- Starches
- Syrups
- Tan Liquor
- Tallow
- Tar
- Tomatoes
- Turpentine
- Varnishes
- Vinegar
- Wine
- Yeast

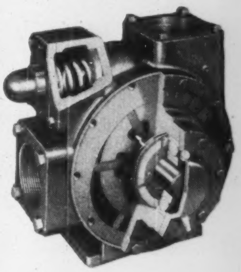
CHECK THESE FEATURES AGAINST YOUR PUMP REQUIREMENTS

Sliding or swinging vanes are self-adjusting for wear and easily replaced.

Liner replacement renews pump.

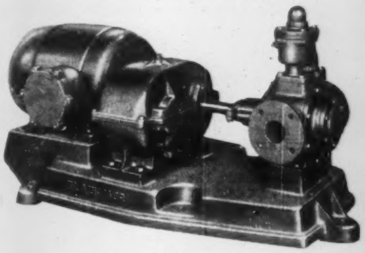
Mechanical shaft seal or chevron packing available.

Capacities from 5 to 1500 G.P.M.



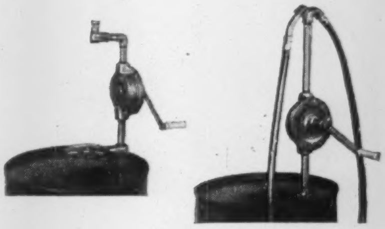
CUT MAINTENANCE AND REPLACEMENT COSTS . . . ELIMINATE OUT OF SERVICE DELAYS!

Twenty years of continual service is not unusual for a Blackmer Pump. When it is necessary to replace the liner or vanes, any mechanic can do so in a matter of minutes.



IN HAND PUMPS AS IN POWER PUMPS . . . BLACKMER PERFORMANCE SPEEDS LIQUID MATERIALS HANDLING

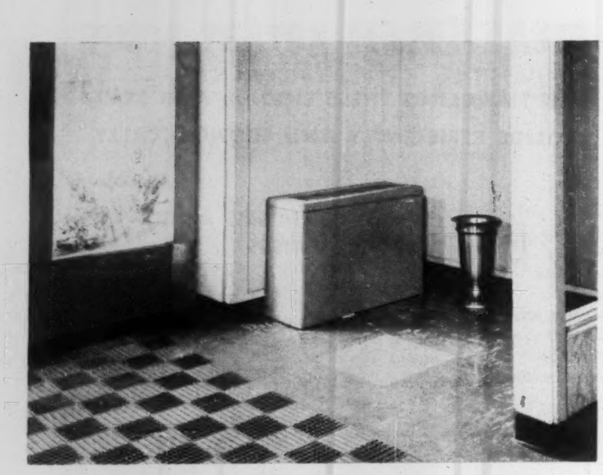
Self-priming with high suction lift. Blackmer Hand Pumps are ideally suited for plant use where spilling of liquids may prove dangerous as well as wasteful. Available in capacities from 7 to 28 G.P.M.



liquid materials handling®

BLACKMER

Industrial, Hand and Truck Pumps, Strainers, Pressure Control Valves
BLACKMER PUMP COMPANY, GRAND RAPIDS 9, MICH.
DIVISION SALES OFFICES — NEW YORK • ATLANTA • CHICAGO
GRAND RAPIDS • DALLAS • WASHINGTON • SAN FRANCISCO
See Yellow pages for your local sales representative



Now cold spots are easy to heat with
CARRIER CABINET UNIT HEATERS

Entrances, lobbies and drafty corridors are but a few of the many spots where these compact Carrier units can vigorously yet gently distribute fan-propelled steam or hot water heat.

Notice above how neatly the floor model can be installed in a modern vestibule. Its design, construction and control features are unsurpassed. Here are a few (which are similarly embodied in its mates designed for ceiling, wall and semi-recessed installations):

1. Modern cabinets of sheet steel with reinforced top panel. Rounded corners. Gray finish.

2. Coil connections permit *concealed* piping inside the cabinet or *external* through end-section knockouts.

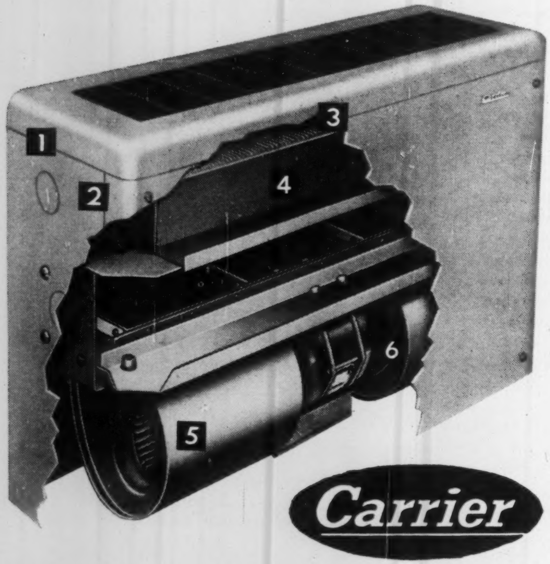
3. Non-ferrous tubes and fins in heating element suitable for operating pressures up to 150 psi saturated steam.

4. Coil can be pitched in either direction. Fitted with air vent and air chamber when used in hot water installation.

5. Twin centrifugal type fan wheels mounted on resilient double-shaft motor. Operates quietly.

6. Each model size employs the same fans, motor and heating element in all styles.

For complete information, WRITE to
Carrier Corporation, Syracuse, New York



Carrier

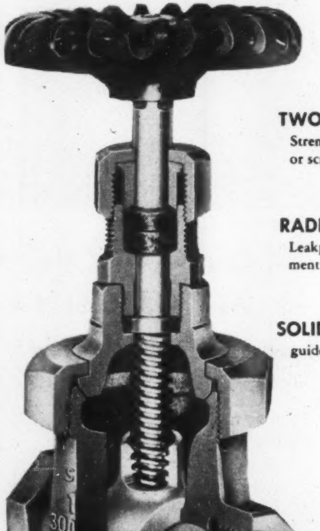
AIR CONDITIONING • REFRIGERATION • INDUSTRIAL HEATING

Designed by EXPERIENCE . . . Proven by SERVICE

FAIRBANKS VALVES VALUES

VALUE — QUALITY — FAIRBANKS synonymous today because of the reputation achieved during a half century of progressive valve development and field service dependability.

The 0260—300 pound Bronze Gate Valve—is a typical valve, a typical value.

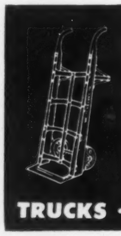


TWO-PIECE UNION BONNET
Strength, quick easy disassembly, no sliding or scraping of seat between body and bonnet.

RADIAL SEAT OF UNION BONNET
Leakproof body-bonnet joint, rigid alignment.

SOLID NICKEL ALLOY WEDGE
guided for tight closure, corrosion resistant.

Fig. 0260 BRONZE GATE VALVE—
NON RISING STEM
300 lbs. steam working pressure at 550°F.
(0264—BRONZE GATE VALVE—RISING STEM)



THE **Fairbanks** COMPANY
393 LAFAYETTE STREET • NEW YORK 3, N.Y.
Branches: New York 3 • Pittsburgh 22 • Boston 10 • Rome, Ga.

TRUCKS • CASTERS • DART & PIC UNIONS • VALVES

WE HEAR THAT

Continued

▶ The West Coast operations of *QUAKER RUBBER CORP.* and its recent acquisition, *PIONEER RUBBER MILLS*, Pittsburg, Calif., have merged under the name of *QUAKER PIONEER RUBBER MILLS., DIV.* of *H. K. PORTER CO., INC.* The division will handle all the sales, manufacturing, and servicing operations of both companies in 10 western states.

▶ Construction of a $100,000 addition to the Northbrook, Ill., plant of *CULLIGAN, INC.* was completed during October. The addition is being used for producing plastic lined water softener tanks which are designed to be corrosion-resistant.

▶ *THE COOPER ALLOY FOUNDRY CO.* announces that, in view of continued extension of facilities and services, the name of the company has been changed to *COOPER ALLOY CORP.*

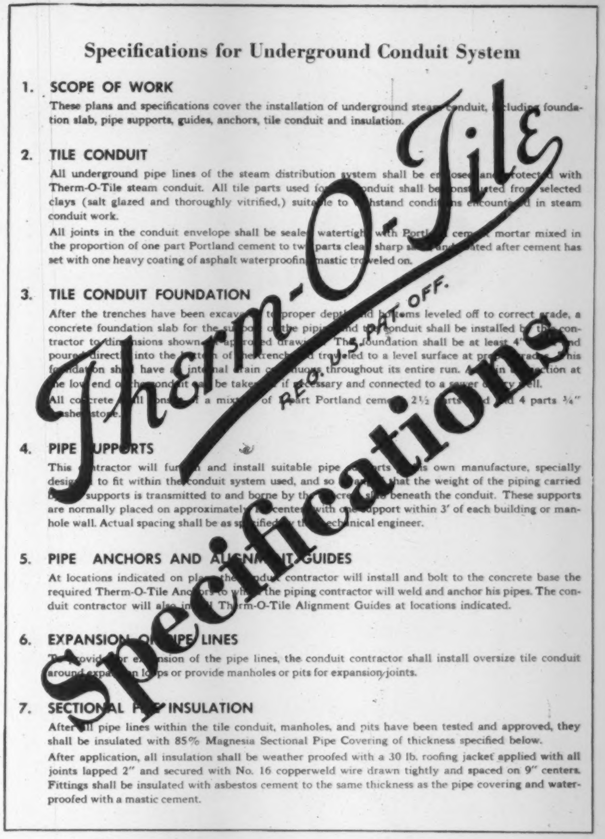
▶ *CLEAVER-BROOKS CO.* has arranged for manufacturing facilities in Canada to build the first sizes (30 and 40 hp) of its new "CB" boiler line. These first boiler units will be followed early in 1955 by the production of sizes up through 125 hp.

▶ Twelve regional merchandising meetings to plan for 1955 advertising and promotion programs, held by *AIRTEMP DIV., CHRYSLER CORP.*, were attended by members of the national sales staff. In addition, Airtemp has expanded training facilities by sponsoring 21, one week special schools and conferences for dealer and distributor personnel.

▶ The 10,000th "Counterflo" industrial, warm air space heater recently rolled off the assembly line at *DRAVO CORP.'s* Neville Island shops. This production was accomplished in "the short period of 13 years," the company reports.

▶ Dealer organizational programs, sales activities and advertising plans were discussed recently in Dayton, Ohio, at a three day commercial refrigeration and air conditioning meeting of *FRIGIDAIRE DIV., GENERAL MOTORS CORP.* executives from 42 branch and distributor sales offices.

▶ *PORTMAR BOILER CO.*, Brooklyn, has opened three additional warehouses in heavy distribution areas. The warehouses—in Watertown, Mass., Philadelphia and Chicago—will furnish stocking facilities for the company's line of commercial, industrial and residential water heaters and heating boilers.


Therm-O-Tile
REG. U.S. PAT. OFF.
Specifications

Specifications for Underground Conduit System

1. SCOPE OF WORK

These plans and specifications cover the installation of underground stea[illegible] conduit, [illegible]cluding foundation slab, pipe supports, guides, anchors, tile conduit and insulation.

2. TILE CONDUIT

All underground pipe lines of the steam distribution system shall be en[illegible] and [illegible]otected with Therm-O-Tile steam conduit. All tile parts used fo[illegible] conduit shall be [illegible] from selected clays (salt glazed and thoroughly vitrified,) suitable to [illegible]hstand condit[illegible]ns encount[illegible] in steam conduit work.

All joints in the conduit envelope shall be seale[illegible] watertigh[illegible] with Portl[illegible] ceme[illegible] mortar mixed in the proportion of one part Portland cement to tw[illegible] parts clea[illegible] sharp [illegible] and [illegible]ated after cement has set with one heavy coating of asphalt waterproofin[illegible] mastic troweled on.

3. TILE CONDUIT FOUNDATION

After the trenches have been excava[illegible] to proper dep[illegible] [illegible] bottoms leveled off to correct grade, a concrete foundation slab for the su[illegible] of the pipi[illegible] and the conduit shall be installed b[illegible] the contractor to dim[illegible]sions shown [illegible] approved draw[illegible] The foundation shall be at least 4" [illegible]nd poure[illegible] direct[illegible] into the [illegible] of the trench [illegible] troweled to a level surface at pr[illegible]rade. This foundation sh[illegible] have [illegible] internal drain co[illegible]uous throughout its entire run. [illegible] in [illegible]ection at [illegible]e low end of the conduit [illegible] be take[illegible] if necessary and connected to a sewer [illegible] well.

All co[illegible]crete [illegible] of [illegible]art Portland ceme[illegible] 2½ [illegible]arts [illegible] 4 parts ¾" [illegible]she[illegible] stone.

4. PIPE [illegible]UPPORTS

This [illegible]ntractor will fur[illegible] and install suitable pipe [illegible]rts [illegible]s own manufacture, specially desig[illegible] to fit within the conduit system used, and so [illegible] that the weight of the piping carried b[illegible] supports is transmitted to and borne by th[illegible] beneath the conduit. These supports are normally placed on approximately [illegible] centers with one support within 3' of each building or manhole wall. Actual spacing shall be as sp[illegible]ecified [illegible] th[illegible]echanical engineer.

5. PIPE ANCHORS AND AL[illegible]GUIDES

At locations indicated on pla[illegible] the [illegible] contractor will install and bolt to the concrete base the required Therm-O-Tile Anc[illegible] to wh[illegible] the piping contractor will weld and anchor his pipes. The conduit contractor will also in[illegible] Therm-O-Tile Alignment Guides at locations indicated.

6. EXPANSION [illegible] LINES

[illegible] provid[illegible] ex[illegible]nsion of the pipe lines, the conduit contractor shall install oversize tile conduit around expa[illegible] lo[illegible]ps or provide manholes or pits for expansion joints.

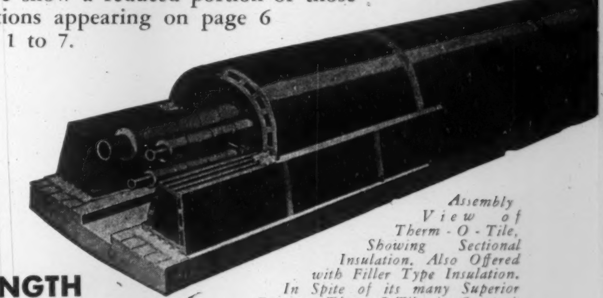
7. SECTIONAL [illegible] INSULATION

After [illegible]ll pipe lines within the tile conduit, manholes, and pits have been tested and approved, they shall be insulated with 85% Magnesia Sectional Pipe Covering of thickness specified below.

After application, all insulation shall be weather proofed with a 30 lb. roofing jacket applied with all joints lapped 2" and secured with No. 16 copperweld wire drawn tightly and spaced on 9" centers. Fittings shall be insulated with asbestos cement to the same thickness as the pipe covering and waterproofed with a mastic cement.

for Underground Pipe

Before writing specifications for underground pipe lines, hot or cold, be sure to have before you a copy of Therm-O-Tile Specifications such as are printed in our Bulletin 511. Above we show a reduced portion of those Specifications appearing on page 6 — items 1 to 7.



Assembly View of Therm-O-Tile, Showing Sectional Insulation. Also Offered with Filler Type Insulation. In Spite of its many Superior Features Therm-O-Tile is Competitive in Total First Cost.

ASK FOR "STRENGTH AFFIDAVITS."

Also, ask for a copy of official strength tests recently made by Pittsburgh Testing Laboratory in strict accordance with ASTM specifications. These STRENGTH AFFIDAVITS prove without question that Therm-O-Tile Conduit more than meets ASTM requirements for EXTRA STRENGTH TILE.

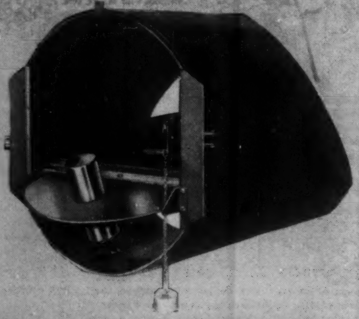
JOHNS-MANVILLE

Write, phone, or telegraph any Porter-Hayden office, as listed below, or, Johns-Manville. Therm-O-Tile is represented by Johns-Manville Technical Service Units in all principal cities.

H. W. PORTER & CO., INC.
822-H Frelinghuysen Avenue • Newark 5, N. J.
REID HAYDEN, INC.
BALTIMORE, MD. RICHMOND, VA. CHARLOTTE, N. C.
Insulation Engineers & Contractors

For commercial & industrial heating with

GAS

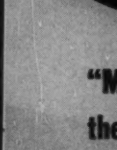


field

"MG" Draft Controls are recommended by the nation's leading gas companies as

SAFE

Now you can eliminate heavy fuel wastes with complete safety. With four years of perfect performance behind it the Field "MG" now carries the recommendation of leading gas companies across the country—fully safe, absolutely dependable, highly efficient. But be sure the control you install is a Field. In a gas installation only a perfect control is a good control.



Write for technical information and performance data on the Field "MG" Draft Control.

FIELD CONTROL DIVISION
of H. D. Conkey & Company — Mendota, Illinois
AFFILIATES: Conco Building Products, Inc. — Brick, Tile, Stone
Conco Materials Handling Division — Cranes, Hoists

WE HEAR THAT

Continued

▶ Construction work has started on a new one story building which provides enlarged facilities for the New Orleans sales office of *MINNEAPOLIS-HONEYWELL REGULATOR CO.* On the corner of Prentiss and St. Roch Sts., it will contain air conditioned offices, a desk for customer accommodations, a warehouse, and control testing and service facilities within its 5000 sq ft of space.

The company has moved its Los Angeles branch and Pacific headquarters personnel into a new $200,000 building at 6620 Telegraph Rd. It covers 21,000 sq ft of a 47,000 sq ft site adjacent to the Santa Ana Freeway. Office area to be occupied by branch sales and manufacturing staff personnel is air conditioned. The remainder of the building is to be used for shop and warehouse purposes.

▶ *OAKITE PRODUCTS, INC.*, recently opened new and expanded laboratories at 350 Hudson St., New York. On opening day, the program included a talk and demonstration on the effects of scale in heat exchangers and the relative efficiency of raw and inhibited acids in scale and rust removal.

▶ *E. K. CLARK*, vice president of *JOHNS-MANVILLE SALES CORP.*, was recently elected president of the *NATIONAL MINERAL WOOL ASSOCIATION*.

▶ *OWENS-CORNING FIBERGLAS CORP.* has completed its distributor-contractor organization for "Kaylo" heat insulation, to serve 48 states, the District of Columbia and Alaska. Fifty-seven distributor-contractors have been appointed.

▶ *THE KRUSE ENGINEERING CO.* has moved its business from 40 E. Park St. to 183 N. 13th St., Newark, to allow for expansion and better customer service.

▶ *C. C. McMILLAN INDUSTRIAL SUPPLIES*, Portland, Ore., has recently been formed for the manufacture of "Kemaloid," a new boiler and cooling water treatment. *C. C. McMILLAN*, who heads the firm, was recently manager of Borgana Products Co., and also served with Gabriel Boiler Mfg. Co., and Caleson Engineering Co.

▶ *LEE HEALEY CO.*, Glendale Calif., is planning a national distribution program for its rubber impeller pump line. Recently appointed factory representatives are touring major areas calling on possible distributors.

Picture of a successful drain line installation

DURIRON

Acidproof Drain Pipe

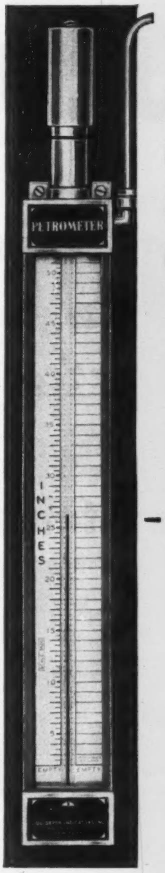
You don't see any drain pipe in the picture because it's in the wall. And if it's DURIRON, you *won't* see it during the entire life of the building.

That's why so much Duriron is specified. It resists corrosion permanently. Think what this means in savings over the installation and reinstallation of less permanent piping. No replacement, no reconstruction during the life of the building, in most cases.

Specify Duriron. Insist upon DURIRON. Available from stock in principal cities.

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, Inc.
Dayton, Ohio



PETROMETER
REMOTE READING
LIQUID DEPTH GAUGES

"Bring Your Liquid Level to Eye Level"

THE BEST GAUGE FOR:

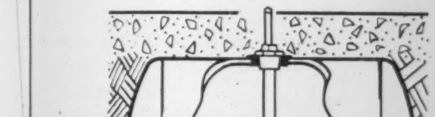
- *Commercial and Industrial Fuel Oil Storage Tanks*
- *Domestic Installations with Buried Tanks*
- *Storage Tanks for other Industrial Liquids—gasoline, solvents, acids, etc.*

HERE'S WHY:

- Can be installed on tanks above or below the ground and up to ¼ of a mile away.
- No troublesome moving parts—operates on the principle of the U-tube. Simple, dependable and accurate.
- Large, easy-to-read vertical scale gives tank contents at a glance. Scales are easily changed for different liquids.
- Easy to install—the tank assembly for the gauge can be installed when the tank is empty or when containing liquid. It can also be installed separately to complete the tank work. The gauge can be connected any time later. Only one simple connection to tighten.

UL
FACTORY MUTUAL FM APPROVED

WRITE FOR BULLETIN PH *TODAY.*



FOR TANKS 20 INCHES TO 50 FEET DEEP.

LIQUIDEPTH INDICATORS, INC.
43-22 TENTH STREET
LONG ISLAND CITY 1, N. Y.

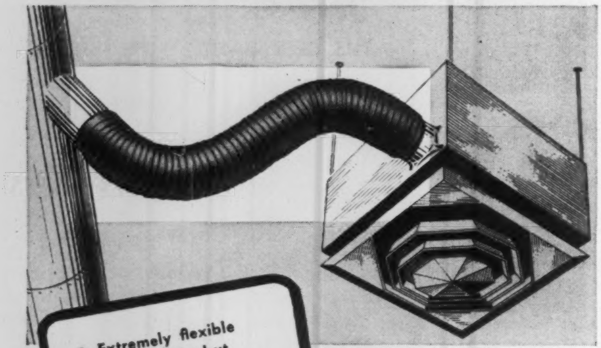
WIREMOLD

flexible

AIR DUCT

tested-proven-preferred

for Commercial Air Conditioning systems



- Extremely flexible
- Light weight but sturdily constructed
- Takes all bends without kinking
- Excellent air flow characteristics
- Waterproof . . . flame resistant

Easy to install ... Saves time, money, effort!

WIREMOLD Flexible Air Duct was developed to meet all requirements for flexible connections in air conditioning systems as specified by leading manufacturers of air distribution equipment.

WIREMOLD Flexible Air Duct's exclusive construction and a specially coated Fibreglas fabric assure maximum longevity. Fabric component is *mechanically locked* into the strong, steel spiral — no glue or other adhesive to dry out or crack.

WIREMOLD AIR DUCT for air conditioning applications was developed through two years of laboratory testing; service-proved in many prominent buildings. Recommended by leading makers of air distribution equipment.

Get the complete story on WIREMOLD Flexible AIR DUCT. Write for Data Sheet S-3.

The WIREMOLD Company
HARTFORD 10, CONNECTICUT

WE HEAR THAT

Continued

▶ *WESTINGHOUSE ELECTRIC CORP.* announces the appropriation of $3,230,000 for facilities to produce window type room air conditioners at its Appliance Div. plant in Springfield Mass. This follows closely the allotment of an even larger sum to cover retooling at the local plant. The operation is part of the company's overall $296 million expansion program, now 75 percent complete.

▶ *YARDLEY PLASTICS CO.*, Columbus, Ohio has set up a new warehousing service in Atlanta, Ga. The new facility is designed to give overnight pickup service to dealers and distributors in the southern states.

▶ *ALAN E. BURDEN CO., INC.*, Los Angeles, has consolidated its facilities in larger quarters at 1940-50 Pontius Ave. The company reports that it is doing three times as much business to date this year as it did during the corresponding period in 1953.

▶ *THE JOHNSON-DAVIS CO.* was recently formed to represent manufacturers in the sale of industrial products. *J. S. DAVIS*, former director of public relations for Borg-Warner Corp., heads the new company as president, with offices at 952 N. Michigan Ave., Chicago. Other officers are *C. S. DAVIS, JR.*, and *J. E. JOHNSON*, vice presidents; *HARVEY WEEKS*, secretary; and *OWEN TRAYNER*, treasurer.

▶ A new cold drawn section, which extends length limitations on rods and tubes and triples capacity for producing heat exchanger tubes, is now in operation at the Huntington, W. Va., works of *THE INTERNATIONAL NICKEL CO., INC.* The unit comprises a building extension 350 ft long by 108 ft wide, a draw bench designed to draw some tubes and rods up to 85 ft and a gas fired annealing furnace 220 ft in overall length.

▶ Ground was broken recently for a new $2 million plant of the *BRIDGEPORT THERMOSTAT DIV., ROBERTSHAW-FULTON CONTROLS CO.* Located in Milford, Conn., six miles from downtown Bridgeport, the one story plant will nearly double the size of the present plant; it will contain 180,000 sq ft of floor space on 15 acres.

▶ Factory personnel of the *SERVEL, INC.*, air conditioning division will conduct a series of sales, application engineering and service schools over a six month period. Qualified personnel of the company's air conditioning distributors and of gas utility companies will be admitted as students.

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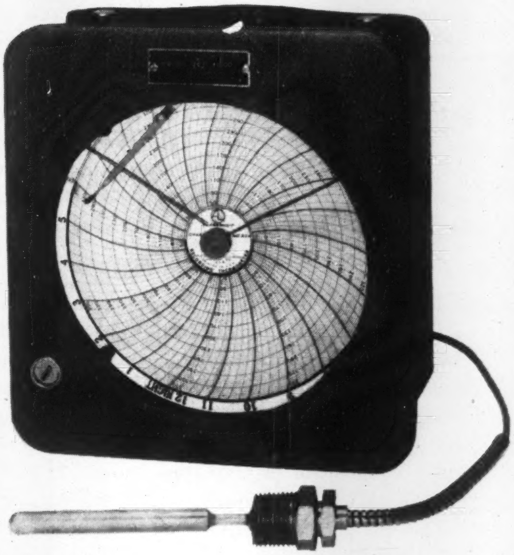

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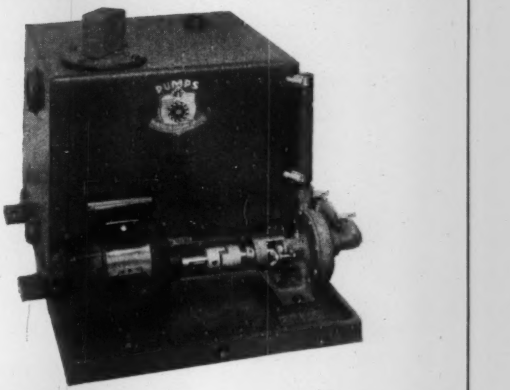

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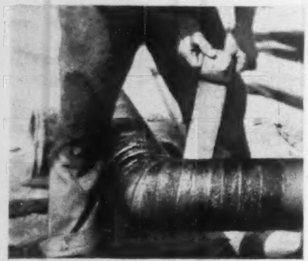

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WE HEAR THAT

Continued

▶ *SURFACE COMBUSTION CORP.* has established a deferred payment plan for the purchase of its industrial equipment. Products covered by this plan include furnaces for the metalworking and producing industries and the glass industry and humidity conditioning equipment for industrial processing and personnel comfort. The plan provides for terms of payment up to three, and in some cases five, years.

▶ *UNION ASBESTOS AND RUBBER CO.* has sold its 110,000 sq ft Paterson, N. J., plant, which was no longer needed due to the consolidation of a major portion of the company's fibrous products manufacturing activities at Bloomington, Ill.

▶ The Virginia Museum of Fine Arts in Richmond is in the process of being completely renovated, including the addition of air conditioning equipment built by *WORTHINGTON CORP.* The company's centrifugal refrigeration compressor, driven by a 250 hp motor, will be the "heart" of the air conditioning system, which is intended primarily to protect the museum's $6 million art collection.

The company's refrigeration equipment will provide artificial ice for a large rink planned as one of the facilities to be offered by a large coliseum now under construction at Charlotte, N. C.

▶ *A-P CONTROLS CORP.* has purchased all the outstanding stock of the *MILWAUKEE VALVE CO.* The purchased company will continue to manufacture a complete line of brass and aluminum valves for heating and other uses. The present plant will be maintained and sales will be made through the same distribution channels. *PHILLIP FINA*, who recently became president of the valve company, will continue as vice president.

▶ *B-I-F- INDUSTRIES, INC.*, Providence, R. I., has formed a new Texas division with sales and service offices in Houston and Dallas, to be known as *B-I-F TEXAS, INC.* B-I-F's West Coast affiliate, *BUILDERS-PACIFIC, INC.*, has changed its name to *B-I-F PACIFIC, INC.*, with offices in San Francisco, Los Angeles and Phoenix. The change was made to more closely identify this division with its parent company.

▶ Two new post-graduate fellowships for engineering and physics students have been established by *MINNEAPOLIS-HONEYWELL REGULATOR CO.* The fellowships have been set up with Purdue University and Tau Beta Pi.

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VIA STEEL
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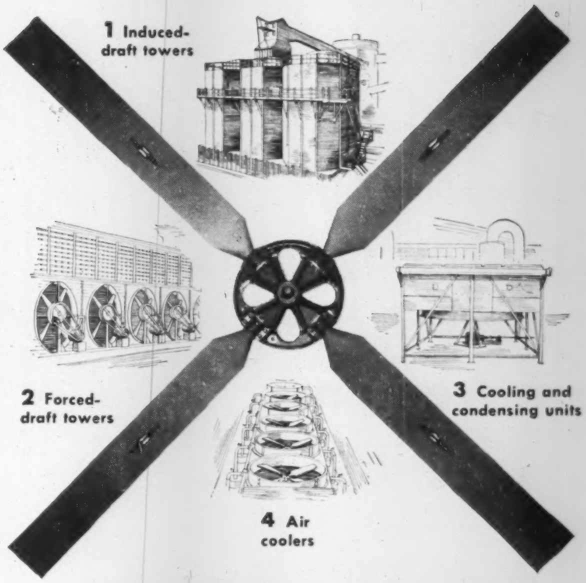

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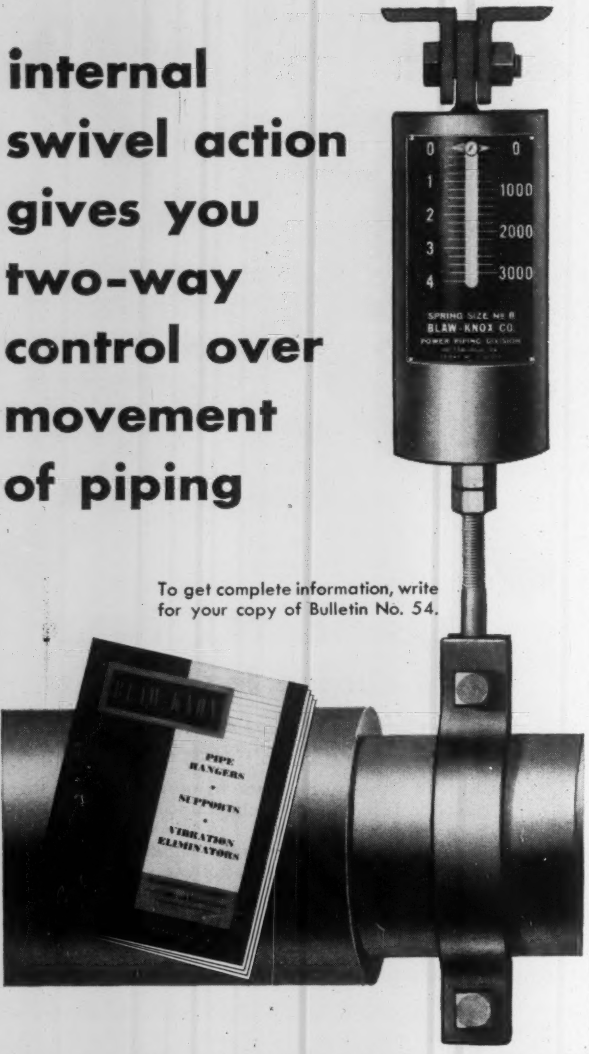

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The fifth edition of this book by William H. Severns, Howard E. Degler, and John C. Miles has been revised from earlier editions with a shift in emphasis to reflect trends in current engineering practice.

Among the additions are new chapters on gas turbines and mechanical refrigeration, the scope of the section on air compressors now includes centrifugal and axial-flow types, specific heat information has been added, and combustion of oils and gases has augmented the chapter on fuel and combustion.

Steam, Air, and Gas Power contains 502 pages, has 297 illustrations. Price is $6.50 from John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y.

Industrial Waste Conference

1954 Proceedings of the Sixth Pacific Northwest Industrial Waste Conference is a compilation of 28 papers that were discussed at the conference, held at the University of Washington, Seattle, on March 18-19.

Of particular interest are *Heating With Atomic Energy*, by Robert T. Jaske, General Electric Co., *Air Pollution Problems With Dispersal of Industry*, by William E. Rand, Director of Research, Stanford Research Institute, and *Control of Cinders and Fly Ash by Utilizing Proper Combustion Techniques and Equipment*, by F. J. Dohrer, Seattle consulting engineer. Proceedings are published by the Office of Short Courses and Conferences, University of Washington, Seattle 5, Wash.

Specifications for Deaerators

The Heat Exchange Institute announces the third edition of its *Standards and Typical Specifications for Deaerators and Deaerating Heaters*. With a general revision from previous editions, the book contains new tables, charts and diagrams. Typical specifications have been revised and brought up to date. Copies may be purchased through members or directly from the Institute, 122 E. 42nd St., New York 17, N.Y.

Industrial Ventilation

As a manual of recommended practice for industrial hygiene, *Industrial Ventilation* answers the need for a source of most recent data on industrial exhaust ventilation, for standardizing ventilation practices and for training new engineers in the ventilation phase of industrial hygiene engineering.

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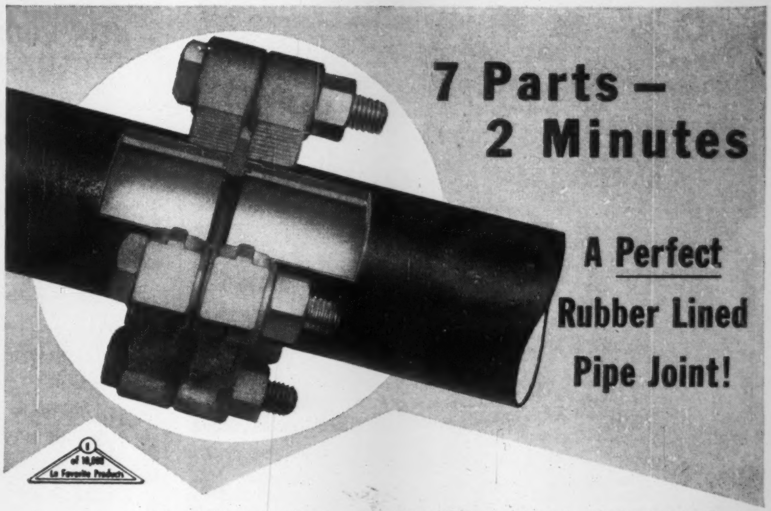

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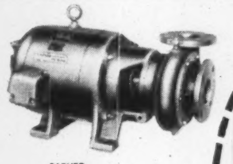

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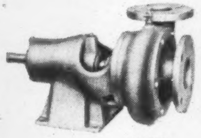

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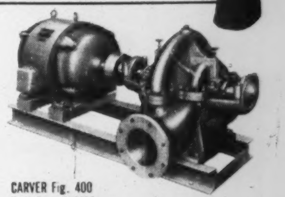

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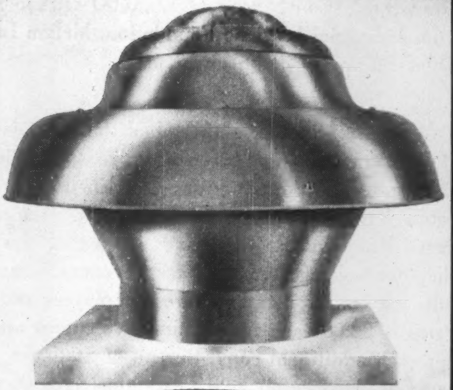

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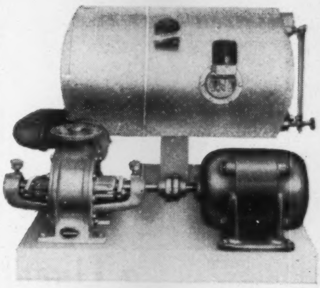

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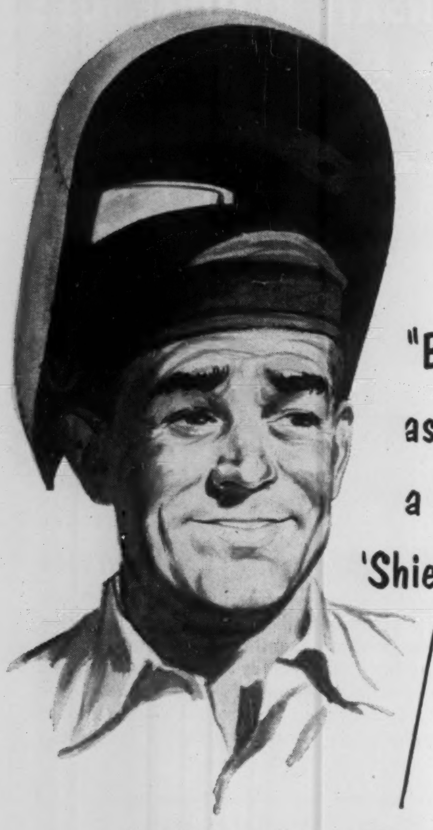

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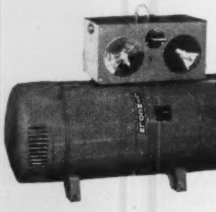

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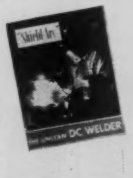

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ENVIRONMENTAL MEDICINE IN INDUSTRY, by C. Richard Walmer, M.D., is available in reprint form. Author defines subject as "a specialized form of medical and public health practice which combines with medicine the sciences of engineering, chemistry, toxicology, psychiatry, sociology, statistics and health promotion." Copies may be obtained without charge from Industrial Hygiene Foundation, Mellon Institute, 440 Fifth Ave., Pittsburgh 13, Pa.

GAS FACTS, the eighth annual statistical yearbook of the American Gas Association, contains 276 pages and presents information and pertinent quantitative data relating to reserves, production, transmission, distribution and underground storage of gas. Other chapters cover customers, sales, revenues, financial results, construction expenditures, employees and prices. Price is $2.00 each for the first five copies and $1.50 per each additional copy. Bureau of Statistics, American Gas Association, 420 Lexington Ave., New York 17, N.Y.

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AIR WASHERS

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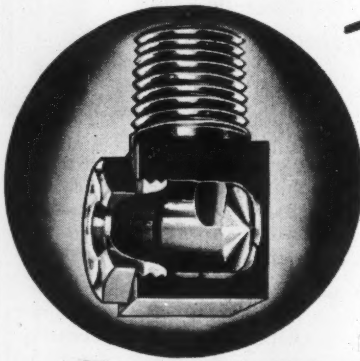

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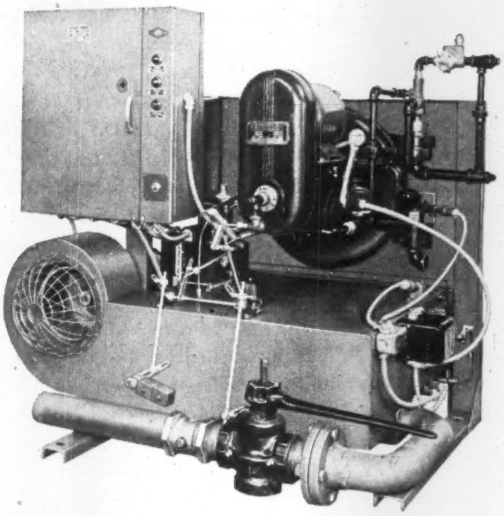
Canadian General Filters Ltd., Toronto 16, Canada

WEBSTER ROTONETIC*



DUAL FUEL FIRING BURNER

- √ **Sizes from 75 to 300 horsepower.**
- √ **Minimum gas pressure requirements.**
- √ **Low installation costs.**
- √ **Maximum efficiencies on BOTH gas and oil.**
- √ **Minimum base height requirements.**
- √ **Utilizes all grades of fuel oil.**
- √ **Extremely low noise level.**
- √ **Approved electronic combustion safeguard system.**
- √ **Simpler changeover than ever before.**
- √ **One hundred per cent forced draft.**
- √ **Completely assembled, piped, wired and tested.**

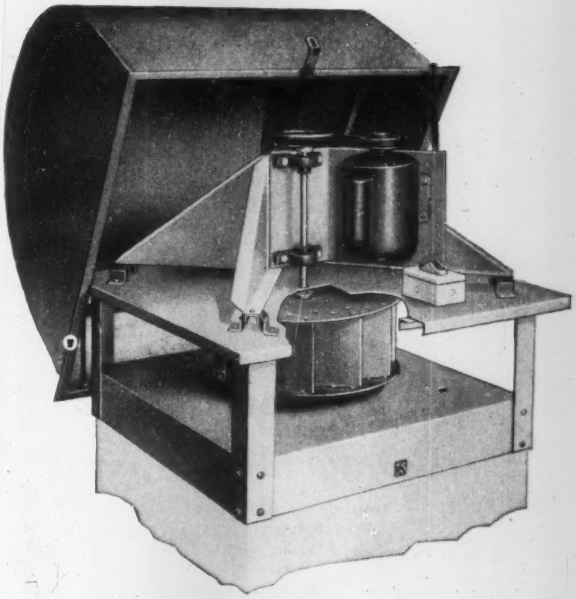
These and many other outstanding features combine to provide the same dependable high quality performance as the WEBSTER DYNETIC gas burner. Neither fuel must suffer if the WEBSTER ROTONETIC is used. With integral pumps, integral oil preheaters for heavy oils, patented oil burner "flame-shaping" vanes, and full modulating or optional high-low control, the WEBSTER ROTONETIC is designed to provide long lasting customer satisfaction the year around.

It is furnished with a precast refractory front as an integral part of the burner assembly. The installer need only finish the furnace wall on each side and above the burner.

Listed by Underwriters' Laboratories, Inc.

*TRADEMARK *Write for Literature*

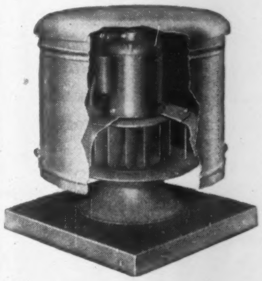
The WEBSTER ENGINEERING COMPANY
TULSA, OKLAHOMA
Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio



Effective *quiet* duct exhaust with Swartwout Airlift

Centrifugal Fan Type Ventilator

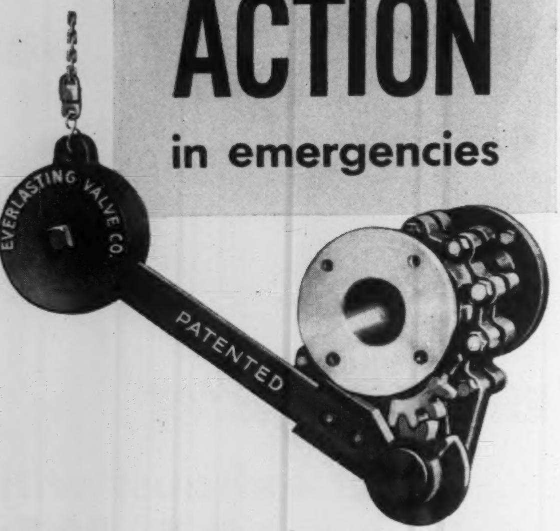
Here's measurable *effective* exhaust capacity at very low noise levels! Quietness alone in duct exhausters isn't enough; you want the capacity needed for the job without wasteful size and cost. Airlift ventilator design features a streamlined fan inlet and oversize outlet opening. Turbulence and friction losses are cut to the minimum. It is often possible to use a smaller size Airlift than ordinarily specified because of the efficiency of both ventilator design and centrifugal fan wheel. The low tip speed of the fan assures quiet operation.



Capacities of the 14 larger Airlift sizes (top illustration) range from 1350 to 32,000 C.F.M.; for Airlift Jr, (left) from 280 to 895 C.F.M. in 4 sizes. Write for Bulletin AL-F.

18568 Euclid Avenue, Cleveland 12, Ohio
The Swartwout Co.
Roof Ventilators and Ventilating Louvers
POWER PLANT EQUIPMENT • PROCESS INDUSTRY CONTROLS

For dependably
QUICK
ACTION
in emergencies



These Everlasting Valves, weight-operated with pendulum stop, assure immediate, positive and unfailing response the instant the weight is released. Their design prevents sticking, binding or wedging, and provides full unimpeded flow when open.

Control can be thermostatic, electric or manual, from any or many locations; and two types are available:

Closing Type (as illustrated)—for emergency shut-off of inflammable liquids, or to concentrate water or steam in fire mains.

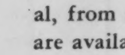
Opening Type—for diversion of water to sprinkler deluge or water curtain systems, or to divert inflammable liquids to a safe point.

These valves are widely used for fuel oil shut-off, dip tank discharge, foam and other emergency protection systems. Write for full details.

EVERLASTING VALVE CO., 61 Fisk St., Jersey City 5, N. J.
Trade Mark "EVERLASTING" Reg. U.S. Pat. Off. EV368A

Everlasting Valves

for everlasting protection



NEW BOOKS & REPORTS

Continued

PROCEEDINGS OF THE THIRD ANNUAL WATER SYMPOSIUM ON WATER POLLUTION, held December 14-15, 1953, bulletin 43 from the Engineering Experiment Station, Louisiana State University, Baton Rouge, is available, the Station has announced. The price is 50c from the University.

A pocket sized guide, *RULES AND REGULATIONS FOR THE INSTALLATION, MAINTENANCE AND USE OF PIPING, APPLIANCES AND FITTINGS FOR GAS* contains an alphabetical table of contents for ready reference. Content is arranged by a decimal paragraph system. Dept. of Public Utilities, City of Richmond, Va.

INDUSTRIAL DEFENSE PLANNING MANUAL—IRON AND STEEL, published by the American Iron and Steel Institute for Business and Services Administration, U.S. Department of Commerce, is directed to industry as a guide to the solution of problems which may arise such as continuity of production and management and protection of company assets in the event of A- or H-Bomb attack or similar emergency. Copies are 50c from the Institute at 350 Fifth Ave., New York 1, N.Y. Copies in quantity may be made available at a special rate.

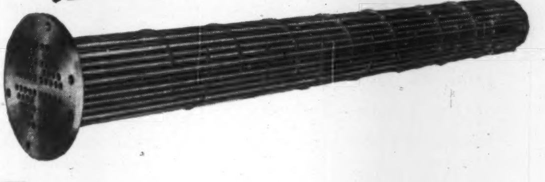
G&O COILS for **HEATING and COOLING**

G&O RADIATION

A full line of sizes now available to meet all industrial requirements. Send for catalog.

THE G&O MANUFACTURING COMPANY
New Haven 8, Connecticut
Pioneer Manufacturers of Square Finned Tubing in the United States

AIR
CONDITIONING
ENGINEERS
AND
CONTRACTORS



Taco

"CONTROLLED VELOCITY" CHILLERS

① Improved heat transfer
② No oil logging or slop over
③ Rapid response to Thermal Expansion Valve

HERE ARE THE FACTS . . .

- All incoming liquid is carried to the top of the Chiller in the first pass.
- All refrigerant and oil are in constant movement forward.
- No liquid (refrigerant or oil) can accumulate in any part of the Chiller.
- At each head pass, liquid refrigerant and oil are agitated by a constant stream of expanding gas.
- Flow of refrigerant and oil is unretarded . . . free of "traps" and short radii.

For full details and application data, send for Bulletin CWF and schematic on "Controlled Velocity"

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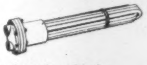
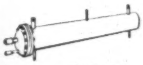
Circulating Pumps

TACO HEATERS, INCORPORATED
1160 Cranston St.
Cranston 9, R. I.


Tank Heating Units

Condensate Coolers
Converters
Fuel Oil Heaters
Oil Coolers
Radiation Heaters
Water Heaters


Chillers

FLEXIFLO

THE DIFFUSER WITH A BUILT-IN VOLUME CONTROL

FLEXIFLO adjustable air diffusers reduce installation costs by providing for rapid, easy adjustment of air volume and pattern after installation by simple knob adjustment.

Engineering is simplified since the FLEXIFLO's wide range of adjustability provides wide latitude in selecting the correct size diffuser.

FLEXIFLO diffusers assure uniform air distribution with built-in equalizing deflectors which are easily adjustable *after* installation. Rapid draftless mixture of supply and room air is assured.

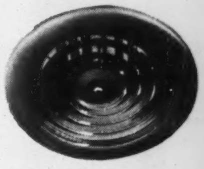
FLEXIFLO diffusers for every cooling, ventilating and heating need are made in 12 standard sizes, up to a capacity of 12,000 CFM.

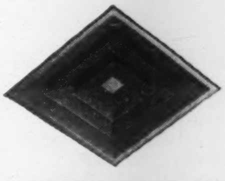
FOR COOLING

TYPE R—Air travels in a constant pattern parallel to the ceiling regardless of volume adjustment.

FOR COOLING & HEATING

TYPE V—Air diffusion pattern and volume are fully adjusable, after installation.



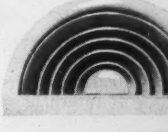


SQUARE

TYPE H — Fully adjustable square diffusers and fixed rectangular 2, 3, and 4 way diffusers.

FOR SIDEWALL & CEILING

TYPE S — With Type R or V blades to supply desired air pattern for ceiling or wall installation.



Write for technical data catalog on Flexiflo line

FLEXIFLO

Universal Diffuser Corp.
1350 Garrison Ave. • New York 59, N. Y.

FRESH AIR . . . ANYWHERE
HOSPITALS
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KITCHENS & LAUNDRIES
FOOD PROCESSING PLANTS
WITH MUCKLE VENTS

ANY AIR . . . ANYWHERE . . . foul or moist, stale or dry, smoky or gaseous . . it's up and out quickly with a Muckle Vent. Proven performance of Muckle Vents guarantees superior efficiency on any building, under any conditions. Architects and builders who compare specify reliable Muckle Vents. For greater working efficiency or controlled customer comfort . . you can depend on Muckle Vents. Streamlined, propeller driven, roof mounted . . motor out of air stream . . 15 sizes - 254 CFM to 10280 CFM. Write today for FREE Application information

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MOISTURE IS NO PROBLEM
Remove moisture filled air
with maximum efficiency.

MANUFACTURING COMPANY
OWATONNA 8, MINN.

ASTM STANDARDS ON COPPER AND COPPER ALLOYS contains 600 pages of 123 ASTM standards presented in a compact, readily usable form. Copies, with heavy paper cover, can be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $5.00 per copy; $5.65, cloth cover.

PLASTICS ENGINEERING HANDBOOK contains 850 pages, over 500 illustrations, diagrams, charts, tables and three special fold-out inserts. Covered are design, materials, processes, equipment, finishing, assembly, testing and standards of plastics and plastics products. This second edition, issued by The Society of the Plastics Industry, Inc., is published by the Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Price is $15.00 per copy.

PRINCIPLES OF NEW PLANT DESIGN FOR HEALTH PROTECTION is a 17 page reprint from the Transactions of the Technical Conferences of the 18th Annual Meeting of the Industrial Hygiene Foundation held at Mellon Institute, Pittsburgh, November 18, 1953.

TVC *Condensate Pumps*

LOW PRESSURE SYSTEM

LOW RETURN CONNECTION
LOW SPEED, LONG LIFE
CAST IRON RECEIVER
SINGLE OR DUPLEX

A SINGLE UNIT easily converted at any time to a DUPLEX UNIT

Specify the "Convertible" TVC in the 15 gallon receiver when ordering low pressure system condensate pumps.
Capacities from 500 to 10,000 sq. ft. E.D.R.

Available from Jobbers' Stock

The Single Unit TVC Condensate Pump in a 15 gallon receiver can be converted to a DUPLEX UNIT whenever load or other conditions require. Each receiver is furnished machined and drilled for the addition of another pump and control.

Conversion to a Duplex Unit doubles the capacity of the unit, or where desired, provides a stand-by pump. Additional pump is installed right on the job. Removal of the unit is unnecessary.

- **Dimensions**

15 gallon cast iron receiver for single or duplex units: diameter 25½", height of return above floor—7$\frac{3}{16}$".
10 gallon cast iron receiver (for single units only): diameter 21", height of return above floor—6⅞".

- **Features**

TVC Condensate Pumps are low speed (1750 RPM) for long life, are readily installed in area where space is important. Their compact cast iron receiver and sturdy pumping unit assure a trouble free installation.

- **Installation**

Simple installation consists of connecting return line to receiver, and connecting discharge to boiler, using a check valve and a gate valve. Unit is completely assembled at the factory. Send for Bulletin TVC300.

weil PUMP CO. 1514 N. FREMONT ST. • CHICAGO 22

NEED Water Heaters?

STORAGE

Whitlock Type K Storage Heater supplies ample hot water at all times. Whitlock-Everdur construction assures lifetime service: also made in Eterno and Standard Steel. A wide range of sizes.

INSTANTANEOUS

Whitlock Type R Instantaneous Heater for use where hot water at a nearly uniform rate is desired. U-tube bundle is removable; other designs available.

CONVERTOR

Whitlock Type R Convertor is used for space heating systems in all types of buildings. The two-pass design furnishes hot water with minimum pressure drop. Made in full range of sizes, for typical pressures.

Whitlock has had extensive experience in the design and manufacture of Water Heaters for thousands of installations including those in hospitals, laundries, textile mills, hotels, schools, and industrial plants. We will gladly assist you with any water heating problems. Ask us for recommendations when you need such equipment. The Whitlock Manufacturing Company, 44 South Street, West Hartford 10, Connecticut. New York, Philadelphia, Boston, Detroit, Chicago, Richmond. Authorized representatives in other principal cities. In Canada: Darling Brothers, Ltd., Montreal.

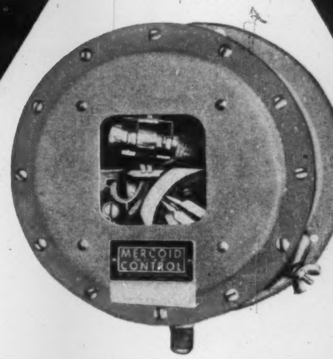
Whitlock

WHITLOCK Designs and builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

MERCOID®

PRESSURE CONTROLS

FOR OUTDOOR SERVICE



HERE'S ANOTHER MERCOID PRODUCT DESIGNED TO OUTPERFORM AND OUTLAST ORDINARY TYPES OF PRESSURE CONTROLS.

Conforms to Nema specifications 1A (semi-dust tight), 2 (drip tight), 3 (weather resistant, weather proof, splash proof, sleet proof, moisture resistant and rain tight), 4 water tight (hose test).

The case and cover are zinc plated steel having a coating that will withstand a 50-hour salt spray test. The cover provides for visible inspection of the sealed Mercoid mercury contact and the calibrated dial. Adjustments are external. Electrical connection is made by means of a ½-inch tapered pipe protruding back of control case.

IT'S AVAILABLE IN

17 DIFFERENT PRESSURE RANGES FROM 0-30" VAC. TO 300-2500 P.S.I.

WITH THE SENSITIVITY YOUR APPLICATION REQUIRES

WRITE FOR BULLETIN 14 PW

THE MERCOID CORPORATION

4201 BELMONT AVE., CHICAGO 41, ILLINOIS

New York: 205 E. 42nd Street • Philadelphia: 3137 N. Broad Street

Sterlco® CONDENSATE PUMPS Engineered to the job!

COMPACT DESIGN
Large capacity tank provides plenty of condensate storage in a minimum floor space. Low inlet and all over simplicity of design eliminates unnecessary gadgets and excessive weight.

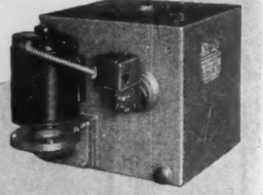
MOTOR
Vertically mounted—capacitor type. Dynamically balanced, permanently lubricated with automatic thermal overload.

FLOAT SWITCH
New, rugged, positive action float switch — easily adjustable to suit the requirements of a specific installation. Float switch and motor wired.

ROTARY SEAL
Good for thousands of hours of normal service — keeps corrosive condensate from motor shaft.

BRONZE IMPELLER
No close clearances — no shimming or adjustment.

SERIES 4200
Cast iron tank



SERIES 4100
Steel tank — same operating features

and EASY TO STOCK!
Only two sizes required to take care of jobs up to 15,000 sq. ft. E.D.R. — and up to 20 lbs. discharge pressure. *For you* this means less working capital tied up in floor stock. *For your customers* this means future increase in radiation may not require a new pump.

Sterlco Products Distributed through
LEADING HEATING and PLUMBING WHOLESALERS

STEAM HEATING is MODERN, EFFICIENT and DEPENDABLE

STERLING, INC.
3732 N. Holton St., Milwaukee 12, Wisconsin

CONDENSATION AND VACUUM PUMPS
HEATING SPECIALTIES
TEMPERATURE CONTROLS

MEETINGS & CONVENTIONS

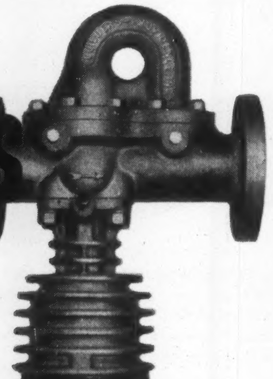
I-B-R SCHOOL OF MODERN HEATING—continuing in November, an intensive one-day course on baseboard series loop installations is being given. Courses are: November 9, White Plains, N.Y.; November 11, Poughkeepsie, N.Y.; November 16, Utica, N.Y.; November 18, Syracuse, N.Y.

Tuition for the one-day baseboard course is $10. Further information may be obtained by writing to the new headquarters of the Institute of Boiler and Radiator Manufacturers, 608 Fifth Ave., Room 408, New York City.

INDUSTRIAL HYGIENE FOUNDATION—19th annual meeting to be held at Mellon Institute, Pittsburgh, Pa., November 17 and 18. Medical, engineering, chemical-toxicological, legal and joint medical-legal conferences will be held on the first day and the main meeting, designed particularly for management, on the 18th. 800 representatives from the 360 member companies of the Foundation are expected to be present.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS—fourth annual conference of the Western Region, November 18-19, Hotel Biltmore, Los Angeles.

pounds



NOT GUESSES

Install BUILDERS SHUNTFLO STEAM METERS right in your steam lines. Keep track of steam costs by seeing where steam is going and how much. Shuntflo Meters available in Model SMKS (shown) for 2″ to 14″ lines — Model SMDH for 1″ and 1½″ lines. **Write for Shuntflo Bulletins. Builders-Providence, Inc. (Division of B-I-F Industries, Inc.), 381 Harris Ave., Providence 1, R. I.**

BUILDERS-PROVIDENCE
DIVISION OF B-I-F INDUSTRIES, INC.
METERS FEEDERS CONTROLS

Now you can enjoy all the Wonderful Benefits of

Combustioneer

MODULATING STOKERS

at Installation Savings Up To $500.00 per Stoker

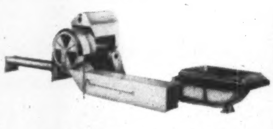
• The reason for the savings is quite simple! The famous Combustioneer "Type L" Gear Drive is "made to order" for Modulating Controls. Its adaptation to Modulating Controls is much less costly . . . savings up to $500 per stoker are not uncommon.

Furthermore, with Combustioneer's Modulating Controls you continue to save important money every day. The controls level off peaks and valleys in coal feeding, prevent over-firing and waste of coal! They keep more heat in the boiler, reduce stack losses, use less fuel during "off" periods, save operator's time and assure smoke-free stacks. They accomplish all this by *automatically* feeding coal and air to the fire at *variable* rates to meet exact load requirements.

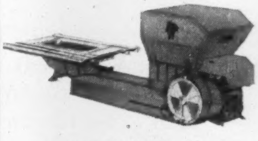
Combustioneer Modulating Stokers range in capacity from 200 to 1000 lbs. per hour. Their rugged construction assures long life in hard service. They are available in both Hopper and Bin-Feed Models.

Write today for Architect's Heating Manual containing complete Combustioneer data and specifications.

Combustioneer Division
The Steel Products Engineering Company
1210 W. Columbia St., Springfield, Ohio



Bin-Feed Model No. 20



Hopper Model No. 50

Combustioneer

Gas Burners • High and Low Pressure Oil Burners
Oil Furnaces • Stokers • Humidifiers

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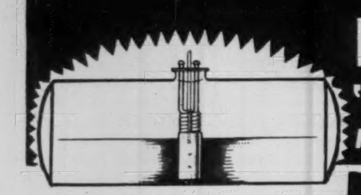
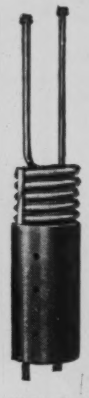
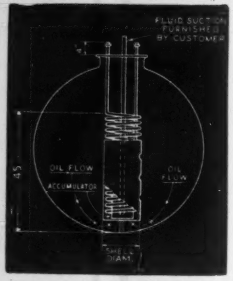
If you would like your name listed on our records for inquiries we may receive on your territory, we invite you to write us. There is no charge in connection with this service.

HEATING, PIPING & AIR CONDITIONING
6 North Michigan Avenue Chicago 2, Illinois

PREHEAT HEAVY OILS IN STORAGE TANKS

REMPE "Hot Spot" PREHEATER

Preheats fuel oils and other liquids to proper flow temperature before entering the suction line.

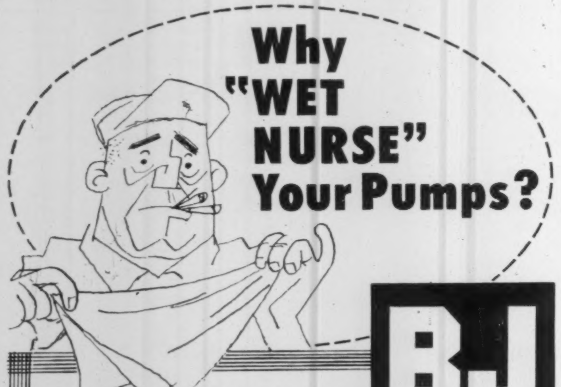
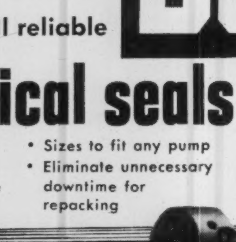
No. 5 and Bunker C oils flow more freely at high temperatures—have greater BTU value. The Rempe "Hot-Spot" does the preheating job efficiently. Takes the load off the suction pump. All-steel construction. Inlet and outlet pipes furnished in required lengths for any diameter tank. Steam or Hot Water can be used as heat source. Made with 14" or 16" diameter shell. Complete facilities for fabrication of pipe coils — all types — all materials. Engineering service. Send details for price.

Write for details and price

HEAT TRANSFER EQUIPMENT REMPE CO. Founded 1890

REMPE COMPANY

342 N. Sacramento Blvd., Chicago 12, Ill.

Why "WET NURSE" Your Pumps?

BJ

install reliable

mechanical seals

- Easy to install and maintain
- Protect against volatile liquid hazards
- Sizes to fit any pump
- Eliminate unnecessary downtime for repacking

Telephone your nearby BJ Pump sales office or contact:

Byron Jackson Co. Since 1872

P.O Box 2017,
Terminal Annex
Los Angeles 54,
California

MEETINGS & CONVENTIONS

Continued

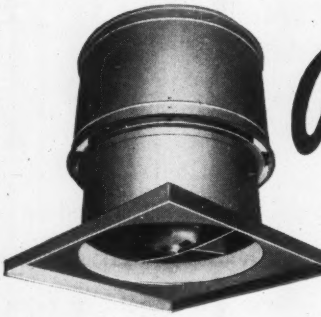
The conference will follow a short course at the University of California. Technical sessions include marine and steel water pipe corrosion problems and the uses of concrete and bituminous coatings on water piping. Registration chairman is J. G. Kerr, C. F. Braun & Co., 1000 S. Fremont Ave., Alhambra, Calif.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, 234 Fifth Ave., New York 1—50th annual meeting, Philadelphia, November 28-December 1.

FIRST INTERNATIONAL AUTOMATION EXPOSITION, 845 Ridge Ave., Pittsburgh 12—exhibit on automatic machines, factories and industries to be held the week of November 29 at the 242nd Coast Artillery Armory, 14th St. off Sixth Ave., New York.

The exhibit is under the direction of Richard Rimbach.

21st *NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING*, under the management of the International Exposition Co., 480 Lexington Ave., New York 17—Commercial Museum, Philadelphia, December 2-7. The dates were arranged



For removing a LARGE VOLUME of Fumes or Air at HIGH VELOCITY

allen VERTICAL DISCHARGE FAN

Whenever you face the problem of discharging fumes or vapors through a roof ventilator so that they will not short circuit back through building openings, you'll find the solution in this new Vertical Discharge Fan. It is designed especially for industrial applications that require the removal of a large volume at high velocity. The "VD" roof fan is fabricated of zinc-coated iron sheet with welded construction throughout. Automatic wing dampers open with air blast, close weathertight when not operating. The "VD" is available as direct drive with motor mounted inside air stream or as "VDR" with motor mounted outside throat of ventilator. Either type is available in a wide range of capacities and sizes.

Write for catalog on complete line of roof ventilators.

ALLEN ENGINEERED VENTILATION

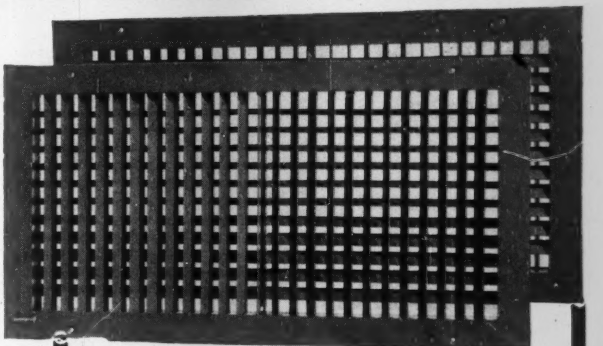
ALLEN COOLER & VENTILATOR INC.
ROCHESTER, MICH.

Roof Ventilators for Every Commercial and Industrial Need

See This Sensational New Heating & Ventilating

GRILLE WITH DETACHABLE VOLUME CONTROL!

- **Increased Directional Control**
- **Eliminates Possibility of Tampering or Accidental Changes**
- **Meters Air-flow Accurately**



New features never before available . . . increased directional control, tamper-proof regulating, unmatched beauty, rugged strength and extreme ease of installation.
Extruded aluminum vanes are individually adjustable. Their unique shape provides greater directional control, and reduces air resistance to a minimum. This means more accurate balancing.
Each vane individually controlled. Operates under spring-loaded tension, eliminating any possibility of deflection pattern being altered by accident or tampering.
Fully-enclosed, wrap-around frame makes grille sturdier, assures easier, safer installation. Entire mechanism is concealed eliminating possibility of "air leaks".
Series "400" A-J Grilles (with — or without volume control) available in any size. Choice of vertical or horizontal louvers only — or combination of both, with either louver in front. Both sets of louvers adjustable without removing grille. Available in prime coat, hammered bronze or metallic gray or any standard finish.

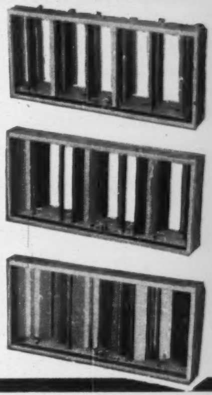
For More Information — Call or Write

A-J MANUFACTURING CO.

2119 Washington St., Dept. H-11, Kansas City 8, Mo.

Matching Return Air Grilles Available

NEW DETACHABLE VOLUME CONTROL



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Patent No. 2,610,267

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The *Yula-trol* is connected with a probe in the shell of the Fuel Oil Pre-heater. If water is displaced from contact with the probe by oil or air, the Yula-trol instantly shuts off heating unit. Sounds alarm.

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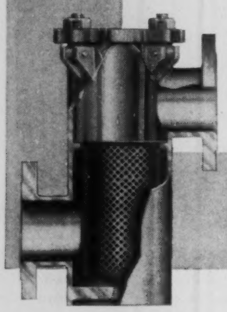

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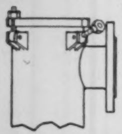

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MEETINGS & CONVENTIONS *Continued*

during the period of the 74th annual meeting of the *AMERICAN SOCIETY OF MECHANICAL ENGINEERS*, under whose auspices the exposition will be held. On Monday, December 6, there will be a joint meeting of the Philadelphia chapters of the American Society of Mechanical Engineers and the American Society of Civil Engineers at Convention Hall. Admission is by invitation and registration only.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS, 62 Worth St., New York 13—61st annual meeting, January 24-27, 1955, Benjamin Franklin and Bellevue-Stratford Hotels, Philadelphia.

INTERNATIONAL HEATING & VENTILATING EXPOSITION—The Air Conditioning Exposition, January 24-28, 1955, Commercial Museum & Convention Hall, Philadelphia. Under the auspices of The American Society of Heating and Ventilating Engineers, and under the management of the International Exposition Co., 480 Lexington Ave., New York 17. Every known method of moving and conditioning air, as well as engineering materials and mechanical components, will be demonstrated.

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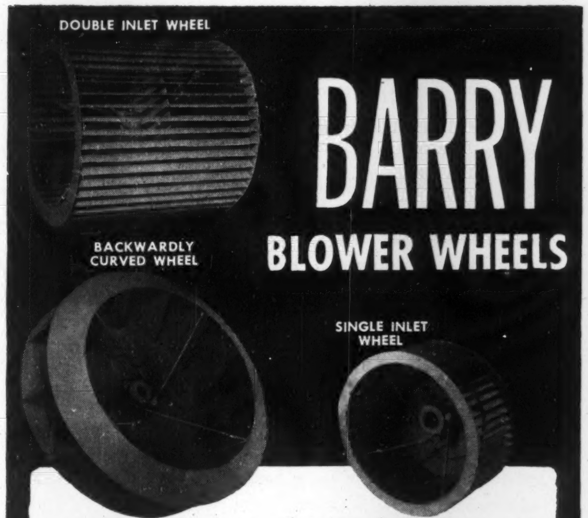

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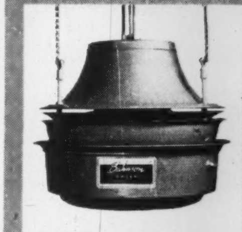

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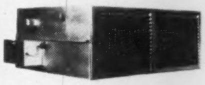

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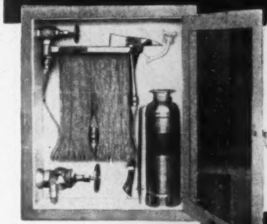

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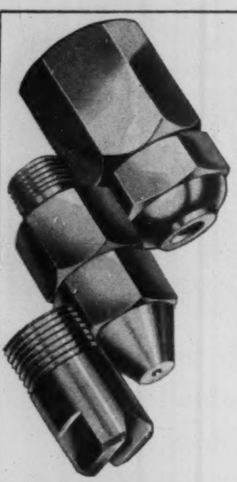

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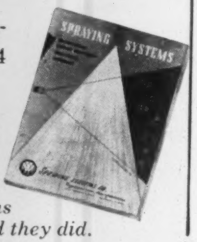

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MEETINGS & CONVENTIONS

Continued

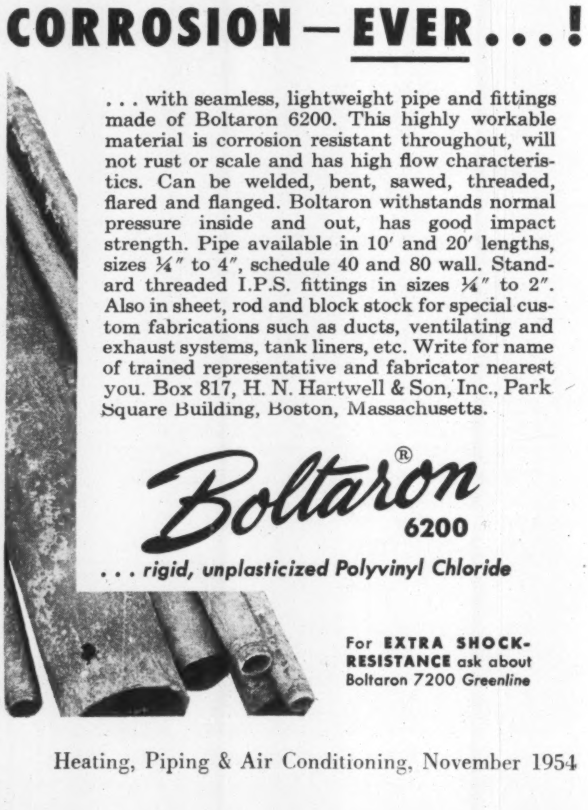
PLANT MAINTENANCE & ENGINEERING SHOW will be held at the International Amphitheater, Chicago, next January 24 to 27. The show, staged for the sixth time, will be the first industrial exposition to occupy the new $2 million hall which has been built in addition to the Amphitheater. Advance registration cards may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

McINTYRE-SARANAC CONFERENCE, February 7-9, 1955, Town Hall, Saranac Lake, N. Y.—conference on silicosis and occupational chest diseases jointly sponsored by the McIntyre Research Foundation of Toronto and the Saranac Laboratory. Write c/o the conference, P.O. Box 551, Saranac Lake, N. Y.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, Tulsa Section—Sixth Annual Corrosion Short Course for Pipeliners, February 16-18, 1955, Mayo Hotel. Thomas M. Ragland, Phillips Petroleum Co., is chairman of the course.

OIL-HEAT INSTITUTE OF AMERICA, 500 Fifth Ave., New York 36—33rd annual convention, tenta-

NO PIPELINE RUST OR CORROSION—EVER. . .!



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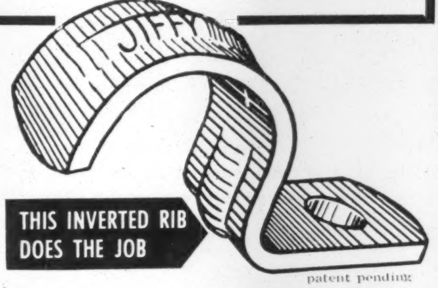
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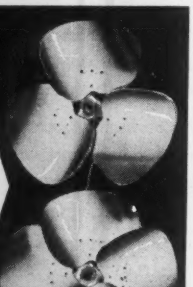

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LOS ANGELES, 25, CAL.

MEETINGS & CONVENTIONS

Continued

tively set for the Edgewater Beach Hotel, Chicago, April 4-7, 1955.

NATIONAL DISTRICT HEATING ASSOCIATION, 827 N. Euclid Ave., Pittsburgh 6—46th annual meeting, Edgewater Beach Hotel, Chicago, May 23-26, 1955.

AMERICAN SOCIETY FOR TESTING MATERIALS, 1916 Race St., Philadelphia 3—annual meeting, June 26-July 1, 1955, Chalfonte-Haddon Hall, Atlantic City, N.J.

The 1955 spring meeting is scheduled for January 31 to February 4 at the Netherland-Plaza Hotel, Cincinnati, Ohio.

9th EXPOSITION OF THE AIR-CONDITIONING AND REFRIGERATION INDUSTRY, Atlantic City, November 28-December 1, 1955—sponsored by the Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington, D. C. The name of the trade show, formerly the All-Industry Refrigeration and Air Conditioning Exposition, has been officially changed.

Statement of Ownership and Management of
HEATING, PIPING & AIR CONDITIONING

for October 1, 1954

The following is a statement of ownership, management, etc., as required by the act of Congress of August 24, 1912, as amended by the acts of March 3, 1933 and July 2, 1946 (Title 39, United States Code, Section 233) of Heating, Piping & Air Conditioning, published monthly at Chicago, Ill., for October 1, 1954:

1. The names and addresses of the publisher, editorial director, editor, and business manager are:

Publisher, F. P. Keeney, Chicago, Illinois.
Editorial Director, C. M. Burnam, Jr., Chicago, Illinois.
Editor, Robert W. Roose, LaGrange, Illinois.
Business Manager, Chas. E. Price, Glencoe, Illinois.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Keeney Publishing Company, 6 North Michigan Avenue, Chicago 2, Illinois. Stockholders: F. P. Keeney, Chicago, Illinois; W. J. Osborn, Fairfield, Conn.; Chas. E. Price, Glencoe, Illinois; Robert A. Jack, Cleveland, Ohio.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

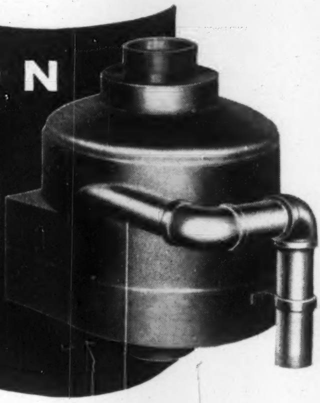
4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

Chas. E. Price, President

Sworn to and subscribed before me this 7th day of September, 1954

Grace E. Waymire.

(SEAL) [My commission expires February 10, 1958]



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To avoid missing any issue of *Heating, Piping & Air Conditioning* it is more important than ever to report both your new and old address to us and your post office. Deadline is the 8th of the preceding month for the next issue. Send changes — and new local postal delivery zone — to

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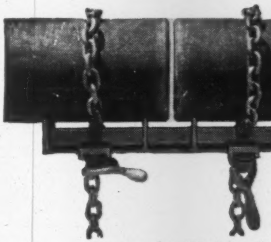

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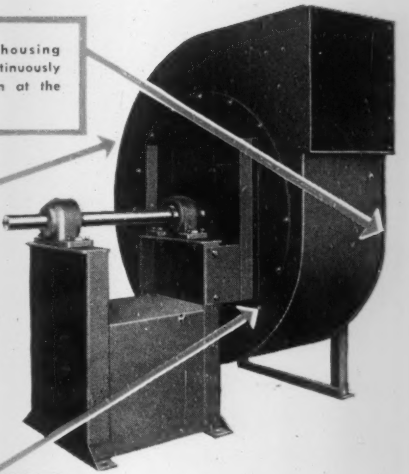

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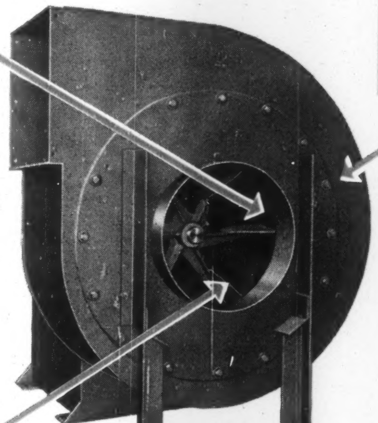

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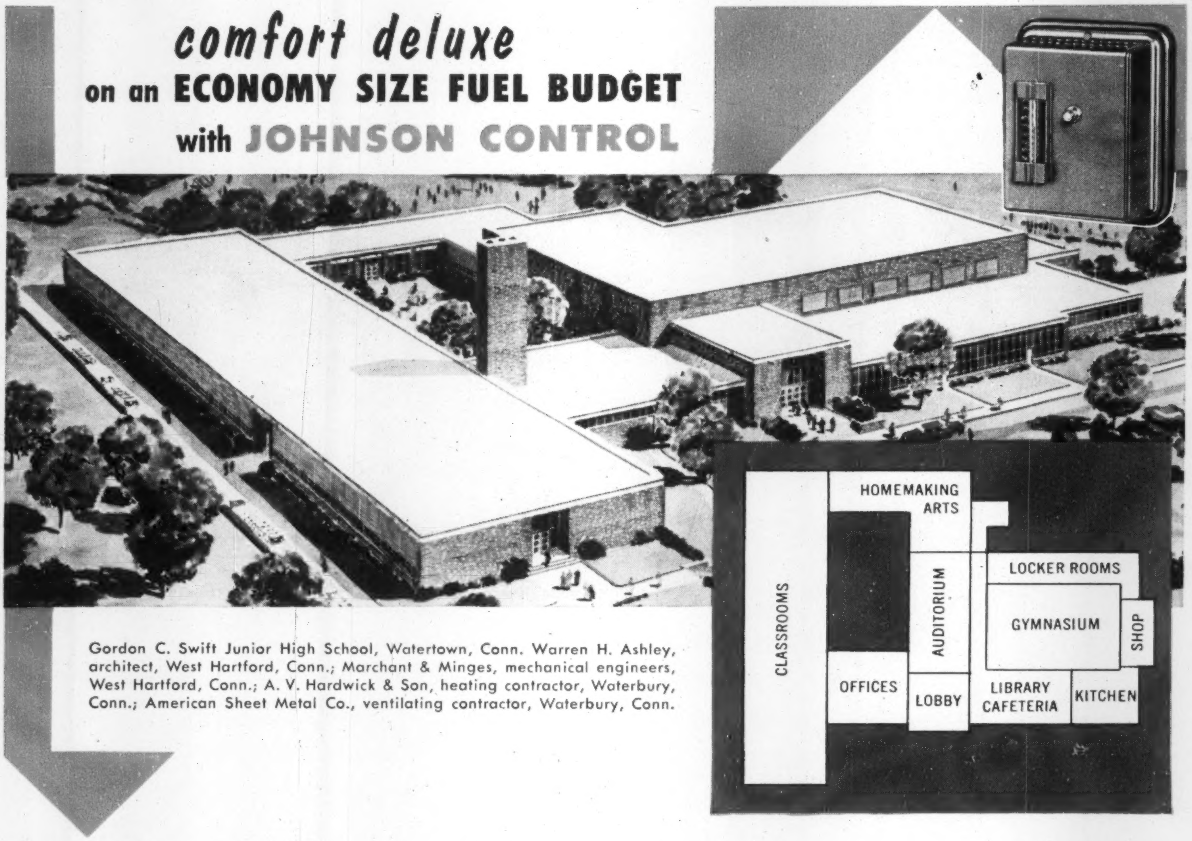

Gordon C. Swift Junior High School, Watertown, Conn. Warren H. Ashley, architect, West Hartford, Conn.; Marchant & Minges, mechanical engineers, West Hartford, Conn.; A. V. Hardwick & Son, heating contractor, Waterbury, Conn.; American Sheet Metal Co., ventilating contractor, Waterbury, Conn.

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